



THE CRISIS OF THE NAVAL WAR



A Mine Exploding.

The Crisis of the Naval War

By

ADMIRAL OF THE FLEET

VISCOUNT JELLICOE OF SCAPA

G.C.B., O.M., G.C.V.O.

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To
The Officers and Men
of our
Convoy, Escort, Patrol and Minesweeping Vessels
and their
Comrades of the Mercantile Marine
by whose splendid gallantry, heroic self-sacrifice, and
unflinching endurance the submarine
danger was defeated

INTRODUCTION

OWING to the peculiar nature and demands of naval warfare, but few dispatches, corresponding to those describing the work and achievements of our great armies, were issued during the progress of the war. In a former volume I attempted to supply this defect in the historical records, which will be available for future generations, so far as the Grand Fleet was concerned, during my period as its Commander-in-Chief. The present volume, which was commenced and nearly completed in 1918, was to have been published at the same time. My departure on a Naval mission early in 1919 prevented me, however, from putting the finishing touches to the manuscript until my return this spring.

I hesitated as to the publication of this portion of what is in effect one complete narrative, but eventually decided not to depart from my original purpose. There is some reason to believe that the account of the work of the Grand Fleet gave the nation a fuller conception of the services which the officers and men of that force rendered in circumstances which were necessarily not easily appreciated by landmen.

This second volume, dealing with the defeat of the enemy's submarine campaign, the gravest peril which ever threatened the population of this country, as well as of the whole Empire, may not be unwelcome as a statement

of facts. They have been set down in order that the sequence and significance of events may be understood, and that the nation may appreciate the debt which it owes, in particular, to the seamen of the Royal Navy and the Mercantile Marine, who kept the seas during the unforgettable days of the intensive campaign.

This book, therefore, gives the outline of the work accomplished by the Navy in combating the unrestricted submarine warfare instituted by the Central Powers in February, 1917. It would have been a labour of love to tell at greater length and in more detail how the menace was gradually overcome by the gallantry, endurance and strenuous work of those serving afloat in ships flying the White or the Red Ensigns, but I had not the necessary materials at my disposal for such an exhaustive record.

The volume is consequently largely concerned with the successive steps taken at the Admiralty to deal with a situation which was always serious, and which at times assumed a very grave aspect. The ultimate result of all Naval warfare must naturally rest with those who are serving afloat, but it is only just to the Naval officers and others who did such fine work at the Admiralty in preparing for the sea effort, that their share in the Navy's final triumph should be known. The writing of this book appeared also to be the only way in which I could show my keen appreciation of the loyalty and devotion to duty of the Naval Staff, of the many clever, ingenious and audacious schemes developed and carried through for the destruction of submarines and the safeguarding of ocean-borne trade, and of the skilful organization which brought into being, and managed with such success, that

great network of convoys by which the sea communications of the Allies were kept open. The volume shows how the officers who accompanied me to the Admiralty from the Grand Fleet at the end of 1916, in association with those already serving in Whitehall and others who joined in 1917, with the necessary and valuable assistance of our comrades of the Mercantile Marine, gradually produced the measures by which the Sea Service conquered the gravest danger which has ever faced the Empire.

There were at times inevitable set-backs as the enemy gained experience of our methods, and new ones had then to be devised, and we were always most seriously handicapped by the strain imposed upon the Fleet by our numerous military and other commitments overseas, and by the difficulty of obtaining supplies of material, owing to the pre-occupation of our industries in meeting the needs of our Armies in equipment and munitions; but, generally speaking, it may be said that in April, 1917, the losses reached their maximum, and that from the following month and onwards the battle was being slowly but gradually won. By the end of the year it was becoming apparent that success was assured.

The volume describes the changes carried out in the Admiralty Staff organization; the position of affairs in regard to submarine warfare in the early part of 1917; and the numerous anti-submarine measures which were devised and brought into operation during the year. The introduction and working of the convoy system is also dealt with. The entry of the United States of America into the war marked the opening of a new phase of the operations by sea, and it has been a pleasure to give particulars of our cordial co-operation with the

United States Navy. The splendid work of the patrol craft and minesweepers is described all too briefly, and I have had to be content to give only a brief summary of the great services of the Dover and Harwich forces.

Finally, an effort has been made to suggest the range and character of the work of the Production Departments at the Admiralty. It is impossible to tell this part of the story without conveying some suggestion of criticism since the output never satisfied our requirements. I have endeavoured also to indicate where it seemed to me that changes in organization were not justified by results, so that in future years we may benefit by the experience gained. But I would not like it to be thought that I did not, and do not, realize the difficulties which handicapped production, or that I did not appreciate to the full the work done by all concerned.

It is unfortunate that attempts to draw attention to the lessons taught us by the war are regarded by many people either as complaints of lack of devotion to the country's interests on the part of some, or as criticisms of others who, in the years before the war or during the war, were responsible for the administration of the Navy. In anticipation of such an attitude, I wish to state emphatically that, where mention is made of apparent shortcomings or of action which, judged by results, did not seem to meet a particular situation, this is done solely in order that on any future occasion of a similar character—and may the day be long postponed—the nation may profit by experience.

Those who are inclined to indulge in criticism should ever bear in mind that the Navy was faced with problems which were never foreseen, and could not have been fore-

seen, by anyone in this country. Who, for instance, would have ever had the temerity to predict that the Navy, confronted by the second greatest Naval Power in the world, would be called upon to maintain free communications across the Channel for many months until the months became years, in face of the naval forces of the enemy established on the Belgian coast, passing millions of men across in safety, as well as vast quantities of stores and munitions? Who would have prophesied that the Navy would have to safeguard the passage of hundreds of thousands of troops from the Dominions to Europe, as well as the movement of tens of thousands of labourers from China and elsewhere? Or who, moreover, would have been believed had he stated that the Navy would be required to keep open the sea communications of huge armies in Macedonia, Egypt, Palestine, Mesopotamia and East Africa, against attack by surface vessels, submarines and mines, whilst at the same time protecting the merchant shipping of ourselves, our Allies, and neutral Powers against similar perils, and assisting to ensure the safety of the troops of the United States when they, in due course, were brought across the Atlantic? Compare those varied tasks with the comparatively modest duties which in pre-war days were generally assigned to the Navy, and it will be seen how much there may be to learn of the lessons of experience, and how sparing we should be of criticism. Wisdom distilled from events which were unforeseeable should find expression not in criticisms of those who did their duty to the best of their ability, but in the taking of wise precautions for the future.

Little mention is made in this volume of the work of

the Grand Fleet during the year 1917, but, although that Fleet had no opportunity of showing its fighting power, it must never be forgotten that without the Grand Fleet, under the distinguished officer who succeeded me as Commander-in-Chief at the end of 1916, all effort would have been of no avail, since every operation by sea, as well as by land, was carried out under the sure protecting shield of that Fleet, which the enemy could not face.

I am conscious of many shortcomings in the book, but it may prove of interest to those who desire to know something of the measures which gradually wore down the German submarine effort, and, at any rate, it is the only record likely to be available in the near future of the work of fighting the submarines in 1917.

June, 1920.

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The Crisis of the Naval War

CHAPTER I

ADMIRALTY ORGANIZATION; THE CHANGES IN 1917

It is perhaps as well that the nation generally remained to a great extent unconscious of the extreme gravity of the situation which developed during the Great War, when the Germans were sinking an increasing volume of merchant tonnage week by week. The people of this country as a whole rose superior to many disheartening events and never lost their sure belief in final victory, but full knowledge of the supreme crisis in our history might have tended to undermine in some quarters that confidence in victory which it was essential should be maintained, and, in any event, the facts could not be disclosed without benefiting the enemy. But the position at times was undoubtedly extremely serious.

At the opening of the war we possessed approximately half the merchant tonnage of the world, but experience during the early part of the struggle revealed that we had not a single ship too many for the great and increasing oversea military liabilities which we were steadily incurring, over and above the responsibility of bringing to these shores the greater part of the food for a population of forty-five million people, as well as nearly all the raw materials which were essential for the manufacture of munitions. The whole of our war efforts, ashore

as well as afloat, depended first and last on an adequate volume of merchant shipping.

It is small wonder, therefore, that those who watched from day to day the increasing toll which the enemy took of the country's sea-carrying power, were sometimes filled with deep concern for the future. Particularly was this the case during the early months of unrestricted submarine warfare in 1917. For if the menace had not been mastered to a considerable extent, and that speedily, not only would the victory of the Allies have been imperilled, but this country would have been brought face to face with conditions approaching starvation. In pre-war days the possibility of these islands being blockaded was frequently discussed; but during the dark days of the unrestricted submarine campaign there was ample excuse for those with imagination to picture the implication of events which were happening from week to week. The memories of those days are already becoming somewhat dim, and as a matter of history and a guide to the future, it is perhaps well that some account should be given, however inadequate, of the dangers which confronted the country and of the means which were adopted to avert the worst consequences of the enemy's campaign without ceasing to exert the increasing pressure of our sea power upon his fighting efficiency, and without diminishing our military efforts overseas.

The latter points were of great importance. It was always necessary to keep the Grand Fleet at a strength that would ensure its instant readiness to move in waters which might be infested by submarines in large numbers should the Germans decide upon some operation by the High Sea Fleet. The possibility of action between the fleets necessitated the maintenance of very strong destroyer forces with the Grand Fleet.

Similarly our oversea military expeditions, with the consequent large number of merchant ships in use as transports or supply ships, required a considerable force of destroyers and other small craft. These commitments greatly reduced the means at our disposal for dealing with the hostile submarines that were attempting to prevent the import of food and raw materials into the country.

Readers of books, and particularly books dealing with war, show a natural avidity for what may be described as the human side of a contest as well as for the dramatic events. But, whether it be prosecuted by sea or by land, war is largely a matter of efficient and adequate organization. It is a common saying that we muddle through our wars, but we could not afford to muddle in face of the threat which the enemy's unrestricted submarine campaign represented. It is impossible, therefore, to approach the history of the successful efforts made by sea to overcome this menace without describing in some detail the work of organization which was carried out at the Admiralty in order to enable the Fleet to fulfil its new mission. In effect those responsible for the naval policy of the country conducted two wars simultaneously, the one on the surface, and the other under the surface. The strategy, tactics and weapons which were appropriate to the former, were to a large extent useless in the contest against mines and submarines which the enemy employed with the utmost persistency and no little ingenuity. Even in the Russo-Japanese war, where the mine was little used, it exerted a marked influence on the course of the war; the Germans based their hopes of victory in the early days of the struggle entirely on a war of attrition, waged against men-of-war, as well as merchant ships. The submarine, which was thrown into the struggle in increasing numbers, represented an entirely new development, for the sub-

marine is a vessel which can travel unseen beneath the water and, while still unseen, except for a possible momentary glimpse of a few inches of periscope, can launch a torpedo at long or short range and with deadly accuracy. In these circumstances it became imperative to organize the Admiralty administration to meet new needs, and to press into the service of the central administration a large number of officers charged with the sole duty of studying the new forms of warfare which the enemy had adopted and of evolving with scientific assistance novel methods of defeating his tactics.

Whilst the enemy's campaign against merchant shipping always gave rise to anxiety, there were certain periods of greatly increased activity. During the summer months of 1916 the losses from submarine attack and from submarine-laid mines were comparatively slight, and, in fact, less than during the latter half of 1915, but in the autumn of 1916 they assumed very serious proportions. This will be seen by reference to the following table, which gives the monthly losses in British, neutral and Allied mercantile gross tonnage from submarine and mine attack alone for the months of May to November inclusive :

May	...	122,798	September...	229,687
June	...	111,719	October ...	352,902
July	...	110,757	November...	327,245
August	...	160,077		

Another disturbing feature was the knowledge that we were not sinking enemy submarines at any appreciable rate, whilst we knew that the Germans had under construction a very large number of these vessels, and that they were thus rapidly adding to their fleet. It was a matter also of common knowledge that our output of

new merchant ships was exceedingly small, and I, in common with others, had urged a policy of greatly increased mercantile ship construction. These facts, combined with the knowledge that our reserves of food and essential raw materials for war purposes were very low, led me, when commanding the Grand Fleet, to the inevitable conclusion that it was essential to concentrate all our naval efforts so far as possible on the submarine menace, and to adopt the most energetic measures for the protection of our sea communications and the destruction of the enemy's submarines. Although it was not easy to see the exact means by which this could be achieved, it appeared necessary as a first step to form an organization having as its sole duty the study of the question, comprising such officers as would be most likely to deal effectively with the problem, supported by the necessary authority to push forward their ideas. Another necessity was the rapid production of such material as was found to be required for anti-submarine measures.

With these ideas in my mind I had written letters to the Admiralty on the subject, and was summoned to a conference in London on November 1 by Mr. Balfour, the First Lord. The whole question of the submarine warfare was fully discussed with Mr. Balfour and Sir Henry Jackson (then First Sea Lord) during the two days spent in London. I had at that time formed and expressed the view that there was very little probability of the High Sea Fleet putting to sea again to risk a Fleet action until the new submarine campaign had been given a thorough trial. With the High Sea Fleet "in being" we could not afford to deplete the Grand Fleet of destroyers, which could under other conditions be employed in anti-submarine work, and therefore the probable German strategy in these circumstances was to keep the Fleet "in being." At

the same time the situation appeared so serious that I went so far as to suggest that one Grand Fleet flotilla of destroyers might under certain conditions be withdrawn for anti-submarine duties in southern waters.

The misgivings which I entertained were, of course, shared by all those in authority who were acquainted with the facts of the case, including the Board of Admiralty.

On November 24 Mr. Balfour telegraphed offering me the post of First Sea Lord, and in the event of acceptance requesting me to meet him in Edinburgh to discuss matters. After consultation with Sir Charles Madden, my Chief of Staff, I replied that I was prepared to do what was considered best for the Service.

During the conference with Mr. Balfour in Edinburgh on November 27, 1916, and after I had agreed to go to the Admiralty, he informed me of the consequent changes which he proposed to make in flag officers' appointments in the Grand Fleet. Amongst the changes he included Admiral Sir Cecil Burney, who would be relieved of his post as second in command of the Grand Fleet and commander of the 1st Battle Squadron, as he had practically completed his term of two years in command. I thereupon asked that he might be offered the post of Second Sea Lord, and that Commodore Lionel Halsey, who had been serving as Captain of the Fleet, might be offered that of Fourth Sea Lord. In my view it was very desirable that an officer with the great experience in command possessed by Sir Cecil Burney should occupy the position of Second Sea Lord under the conditions which existed, and that one who had served afloat during the war in both an executive and administrative capacity should become Fourth Sea Lord. I also informed Mr. Balfour of my desire to form an Anti-Submarine Division of the War Staff at the

Admiralty, and asked that Rear-Admiral A. L. Duff, C.B., should be offered the post of Director of the Division, with Captain F. C. Dreyer, C.B., my Flag Captain in the *Iron Duke*, as his assistant.

All these appointments were made.

Although I arrived in London on November 29, I did not actually take office as First Sea Lord until December 5, owing to an attack of influenza. On that day I relieved Sir Henry Jackson, but only held office under Mr. Balfour for two or three days, as the change of Government took place just at this period, and Sir Edward Carson came to the Admiralty in place of Mr. Balfour.

This book is intended to record facts, and not to touch upon personal matters, but I cannot forbear to mention the extreme cordiality of Sir Edward Carson's relations with the Board in general and myself in particular. His devotion to the naval service was obvious to all, and in him the Navy possessed indeed a true and a powerful friend.

The earliest conversations between the First Lord and myself had relation to the submarine menace, and Sir Edward Carson threw himself wholeheartedly into the work. This was before the days of the unrestricted submarine campaign, and although ships were frequently torpedoed, very large numbers were still being sunk by gun-fire. The torpedo did not come into general use until March, 1917.

One of the most pressing needs of this period of attack by gun-fire was consequently a great increase in the number of guns for use in defensively armed merchant vessels, and here Sir Edward Carson's assistance was of great value. He fully realized the urgent necessities of the case, and was constant in his efforts to procure the neces-

many guns. The work carried out in this connection is given in detail in Chapter III (p. 68).

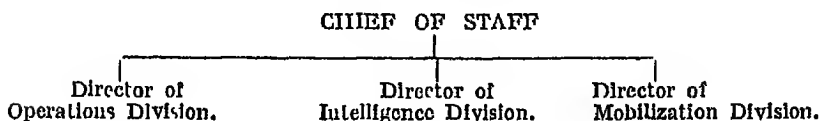
During Sir Edward's tenure of office the reorganization of the Naval Staff was taken in hand. Changes from which great benefit resulted were effected in the Staff organization. Sir Edward very quickly saw the necessity for a considerable strengthening of the Staff. In addition to the newly formed and rapidly expanding Anti-Submarine Division of the Naval Staff, he realized that the Operations Division also needed increased strength, and that it was essential to relieve the First Sea Lord of the mass of administrative work falling upon his shoulders, which had unfortunately been greatly magnified by the circumstances already described.

It is as well at this point to describe the conditions in regard to Staff organization that existed at the Admiralty at the end of 1916, and to show how those conditions had been arrived at.

Prior to 1909 there was no real Staff, although the organization at the Admiralty included an Intelligence Department and a Mobilization Division. The Director of Naval Intelligence at that time acted in an advisory capacity as Chief of the Staff. Indeed prior to 1904 there were but few naval officers at the Admiralty at all beyond those in the technical departments of the Director of Naval Ordnance and Torpedoes and the members of the Board itself. The Sea Lords were even without Naval Assistants and depended entirely on the help of a secretary provided by the civilian staff at the Admiralty.

In 1910 a new branch was formed termed the Mobilization and Movements Department under a Director. This branch was a first step towards an Operations Division.

Under Mr. Churchill's regime at the Admiralty in 1911 a more regular Staff organization was introduced and a Chief of the War Staff, acting under the First Sea Lord, was appointed. The organization introduced during his term of office is thus shown graphically :



In addition to other duties, the Mobilization Division was charged with the responsibility for the supply of fuel to the Fleet, from the Staff point of view.

In the organization introduced in 1911 the duties of the Chief of the Staff were defined as being of an advisory nature. He possessed no executive powers. Consequently all orders affecting the movements of ships required the approval of the First Sea Lord before issue, and the consequence of this over-centralization was that additional work was thrown on the First Sea Lord. The resultant inconvenience was not of much account during peace, but became of importance in war, and as the war progressed the Chief of the Staff gradually exercised executive functions, orders which were not of the first importance being issued by the Staff in accordance with the policy approved generally by the First Sea Lord. The fault in the organization appeared to me to lie in non-recognition of the fact that the First Sea Lord was in reality the Chief of the Naval Staff, since he was charged with the responsibility for the preparation and readiness of the Fleet for war and for all movements. Another anomaly existing at the Admiralty, which was not altered in the 1911 reorganization of the War Staff, was that the orders to the Fleet were not drafted and

issued by the War Staff, but by the Military Branch of the Secretary's Department.

The system was only workable because the very able civil servants of the Military Branch were possessed of wide Admiralty experience and worked in the closest co-operation with the naval officers. Their work was of the most strenuous nature and was carried out with the greatest devotion, but the system was manifestly wrong in principle.

On the outbreak of war the necessity for placing the War Registry (a part of the Military Branch) directly under the Chief of the Staff became apparent, and this was done.

In December, 1916, when I took up the post of First Sea Lord, the Admiralty War Staff was still being worked on the general lines of the organization introduced by Mr. Churchill in 1911, but it had, of course, expanded to a very considerable extent to meet war conditions, and a most important Trade Division, which dealt with all questions connected with the Mercantile Marine, had been formed at the outbreak of war under the charge of Captain Richard Webb. This Division, under that very able officer, had carried out work of the greatest national importance with marked success.

The successive changes in the Staff organization carried out during the year 1917 were as follows :

In December, 1916, an Anti-Submarine Division of the Staff was formed. This Division did not, for some reason, appear in the Navy List as part of the Staff organization until some months had elapsed, although it started work in December, 1916. The officers who composed the Division were shown as borne on the books of H.M.S. *President*.

The Division relieved the Operations Division of the

control of all vessels, including aircraft, which were engaged in anti-submarine offensive and defensive work, and took over also the control of mine-sweeping operations. The Division was also charged with the duty of examining and perfecting all experimental devices for combating the submarine menace and of producing fresh schemes for the destruction of enemy submarines. This organization is open to the criticism that matters concerning operations and material came under the same head, but they were so closely allied at this stage that it was deemed advisable to accept this departure from correct Staff organization. The personnel of the Division came with me from the Grand Fleet, and at the outset consisted of one flag officer—Rear-Admiral A. L. Duff, C.B.—two captains, four commanders, three lieutenant-commanders, and two engineer officers, in addition to the necessary clerical staff. The small staff of four officers already at the Admiralty engaged in anti-submarine experimental work, which had done much to develop this side of warfare, was absorbed. The new Division worked directly under me, but in close touch with the then Chief of the War Staff, Vice-Admiral Sir Henry Oliver.

In the early spring of 1917 the illogical nature of the War Staff organization became apparent, in that it had no executive functions, and as the result of discussions between Sir Edward Carson and myself the decision was taken that the duties of the Naval Staff (the term decided upon in place of that of War Staff) should be made executive, and that the First Sea Lord should assume his correct title as Chief of the Naval Staff, as he had, in fact, already assumed the position.

At the same time the operational work of the Staff was grouped under two heads, the first mainly concerned with operations against the enemy's surface vessels, and

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the second with the protection of trade and operations against the enemy's under-water warfare, whether the means he employed were submarines or mines.

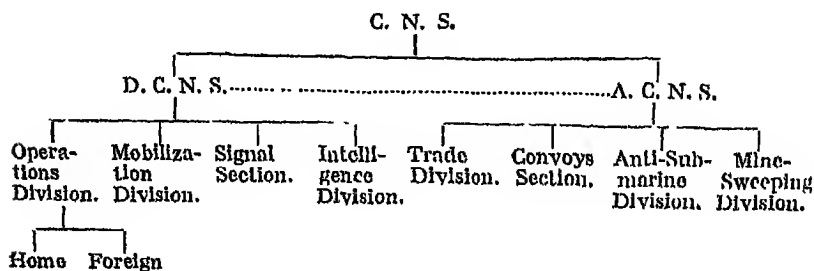
The officer, Vice-Admiral Sir Henry Oliver, K.C.B., charged with the supervision of the first-named work was styled Deputy Chief of the Naval Staff (D.C.N.S.), and the officer connected with the second, Rear-Admiral A. L. Duff, C.B., was given the title of Assistant Chief of the Naval Staff (A.C.N.S.).

The duties of Director of the Anti-Submarine Division of the Staff, hitherto carried out by Admiral Duff, were at this time taken over by Captain W. W. Fisher, C.B., who was brought down from the Grand Fleet for the purpose. Captain Dreyer, who had been Admiral Duff's original assistant, had in the meantime been appointed Director of Naval Ordnance, and had been succeeded by Captain H. Walwyn, D.S.O.

The Mine-Sweeping Division of the Staff was also formed, and the importance of the question of signal communications was recognized by forming a Signal Section of the Staff.

The adoption of the title of Chief of the Naval Staff by the First Sea Lord necessarily made the functions of the Staff executive instead of advisory.

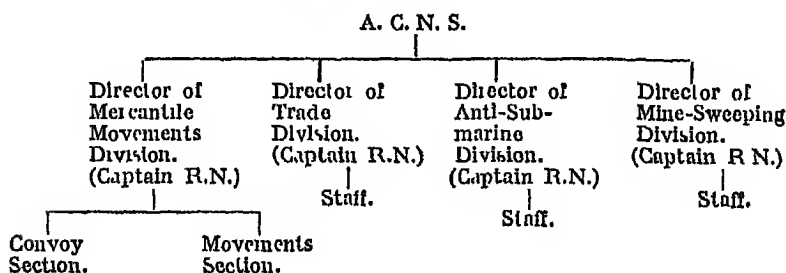
The Staff organization at this period is shown graphically below.



Stress was laid in a Staff memorandum issued by me on the fact that the various divisions were on no account to work in watertight compartments, but were to be in the closest touch with one another. The dotted line connecting the D.C.N.S. and the A.C.N.S. in the graph was defined as indicating that there should be the fullest co-operation between the different portions of the Staff.

In the summer of 1917 the growth of the convoy system necessitated further expansion of the Naval Staff, and a Mercantile Movements Division was added. The duties of this division were to organize and regulate the movements of convoys of merchant ships. A staff of officers had been by this time sent abroad to the ports from which convoys were directed to sail, and the Mercantile Movements Division, acting in close touch with the Ministry of Shipping, arranged the assembly and movements of the convoys and their protection.

The organization of the portion of the Staff under the A.C.N.S. at this stage is shown below.



The portion of the organization under the A.C.N.S. comprised the following numbers in December, 1917 :

Mercantile Movements Division, 86 Officers, with a clerical staff.

Trade Division, 43 Officers, with a clerical staff of 10 civilians.

Anti-Submarine Division, 26 Officers, with a clerical staff.

Mine-Sweeping Division, 8 Officers, with a clerical staff.

Of this number practically the whole of the Mercantile Movements and Anti-Submarine Divisions were added during the year 1917, whilst large additions were also made to the Trade Division, owing to the great increase of work.

During the first half of the year 1917 the Operations Division of the Naval Staff received a much needed increase of strength by the appointment of additional officers, charged, under the Director of the Operations Division, with the detailed preparation of plans for operations. Further additions to this branch of the Staff were made in the latter half of the year.

Matters were in this position with the reorganization of the Naval Staff in hand and working towards a definite conclusion when, to the intense regret of those who had been privileged to work with him, Sir Edward Carson left the Admiralty to become a member of the War Cabinet.

Before leaving the subject of work at the Admiralty during Sir Edward Carson's administration, mention should be made of the progress made in the difficult task of providing officers for the rapidly expanding Fleet. The large programme of small craft started in the early part of 1917 involved the eventual provision of a great number of additional officers. Admiral Sir Cecil Burney, the Second Sea Lord, took this matter in hand with conspicuous success, and the measures which he introduced tideed us over a period of much difficulty and made provision for many months ahead. Sir Cecil Burney, by reason of his intimate knowledge of the personnel—the

result of years of command afloat—was able to settle also many problems relating to personnel which had been the cause of dissatisfaction in the past.

Sir Edward Carson, on leaving the Admiralty, was succeeded by Sir Eric Geddes as First Lord. Sir Eric had been brought into the Admiralty in May, 1917, in circumstances which I will describe later.* One of his first steps as First Lord which affected Admiralty organization was the appointment of a Deputy First Sea Lord. This appointment was frankly made more as a matter of expediency than because any real need had been shown for the creation of such an office. It is unnecessary here to enter into the circumstances which led to the appointment to which I saw objections, owing to the difficulty of fitting into the organization an officer bearing the title of Deputy First Sea Lord.

Vice-Admiral Sir Rosslyn Wemyss—who had come to England for the purpose of conferring with the Admiralty before taking up the post of British Commander-in-Chief in the Mediterranean—was selected by the First Lord as Deputy First Sea Lord.

Shortly after assuming office as First Lord, Sir Eric Geddes expressed a wish for a further consideration of the question of Admiralty organization. To this end he appointed a joint War Office and Admiralty Committee to compare the two organizations.

Having received the report of the Committee, the First Lord and I both formulated ideas for further reorganization. My proposals, so far as they concerned the Naval Staff, were conceived on the general lines of an extension of the organization already adopted since my arrival at the Admiralty, but I also stated that the time had arrived when the whole Admiralty organization should be divided

* *Vide* Chapter X.

more distinctly into two sides, viz., the Operational side and the *Matériel* or Administrative side, and indicated that the arrangement existing in the time of the old Navy Board might be largely followed, in order that questions of Operations and *Matériel* should be quite clearly separated. This, indeed, was the principle of the Staff organization which I had adopted in the Grand Fleet, and I was anxious to extend it to the Admiralty.

This principle was accepted—although the term “Navy Board” was not reinstituted—the Admiralty Board being divided into two Committees, one for *Operations* and one for *Matériel*, the whole Board meeting at least once a week, as required, to discuss important questions affecting both sides. Whilst it was necessary that the Maintenance Committee should be kept acquainted with the requirements in the shape of material needed for operations in which the Fleet was engaged—and to the Deputy Chief of Naval Staff was assigned this particular liaison duty—I was not in favour of *discussing* questions affecting ordinary operations with the whole Board, since, in addition to the delay thereby involved, members of the Maintenance Committee could not keep in sufficiently intimate touch with such matters, and opinions might be formed and conclusions expressed on an incomplete knowledge of facts. Questions of broad policy or of proposed major operations were, of course, in a different category, and the above objections did not apply.

The further alterations in Naval Staff organization were not adopted without considerable discussion and some difference of opinion as to detail, particularly on the subject of the organization of the Operations Division of the Naval Staff, which I considered should embrace the Plans Division as a sub-section in order to avoid over-

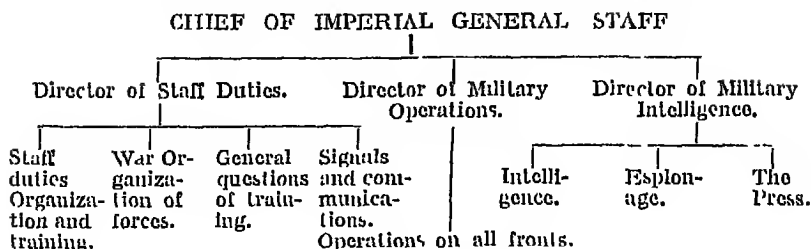
lapping and delay. In my view it was undesirable for a body of officers not working under the authority of those in close touch with the daily operations of the Fleet to put forward plans for operations which necessarily involved the use of the same vessels and material, as such a procedure must inevitably lead to impracticable suggestions and consequent waste of time; the system which I favoured was that in use in the Army, where the Operations Section of the Staff dealt also with the working out of plans.

The Admiralty Staff organization necessarily differed somewhat from that at the War Office, because during the war the Admiralty in a sense combined, so far as Naval operations were concerned, the functions both of the War Office and of General Headquarters in France. This was due primarily to the fact that intelligence was necessarily centred at the Admiralty, and, secondly, because the Admiralty acted in a sense as Commander-in-Chief of all the forces working in the vicinity of the British Isles. It was not possible for the Commander-in-Chief of the Grand Fleet to assume this function, since he could not be provided with the necessary knowledge without great delay being caused, and, further, when he was at sea the other commands would be without a head. The Admiralty therefore necessarily assumed the duty, whilst supplying each command with all the information required for operations. The general lines of the Staff organizations at the War Office and at General Headquarters in France are here given for the sake of comparison with the Naval Staff organization.

1.—*The British War Office.*

The approximate organization is shown as concisely as possible in the following diagram :

The Crisis of the Naval War

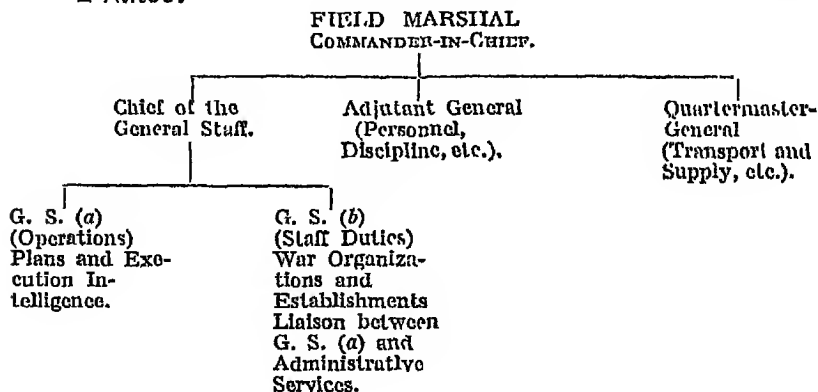


The other important departments of the War Office on the administration side are those of the Adjutant-General and the Quartermaster-General, the former dealing with all questions relating to the personnel of the Army under the various headings of organization, mobilization, pay and discipline, and the latter with all questions of supply and transport.

A Deputy Chief of the Imperial General Staff was attached to the Chief of the Imperial General Staff. His main duty was to act as a liaison between the General Staff and the administrative departments of the War Office.

The whole organization of the British War Office is, of course, under the direction and control of the Secretary of State for War.

2.—*The Staff Organization at General Headquarters in France.*



Admiralty Changes in 1917

19

ATTACHED TO GENERAL HEADQUARTERS.
(BUT NOT STAFF OFFICERS.)

Artillery Adviser
(Advises Chief of
General Staff on
Artillery matters
and operations).

Advises Administrative
Departments as
necessary.

Engineer-in-Chief.
Advises as in case of
Artillery.

Inspector of
Training.

N.B.—The Inspector of Training works in consultation with the Chief of the General Staff.

It will be seen that whilst at the War Office the liaison between the General Staff and the administrative side was maintained by a Deputy Chief of the General Staff, in the organization in the field the same function was performed by the Staff Officer known as G.S. (b).

It will also be seen that neither at General Headquarters nor in the case of an Army command does the Chief of the General Staff exercise control over the administrative side.

After some discussion the Admiralty organizations shown in the Tables A and B on page 20 were adopted, and I guarded as far as possible against the objection to keeping the Plans Division separate from the Operations Division by the issue of detailed orders as to the conduct of the business of the Staff, in which directions were given that the Director of the Plans Division should be in close touch with the Director of the Operations Division before submitting any proposals to the Deputy Chief of Naval Staff or myself.

During the remainder of my service at the Admiralty the organization remained as shown in Tables A and B on p. 20. It was not entirely satisfactory, for reasons already mentioned and because I did not obtain all the relief from administrative work which was so desirable.

Table A

FIRST SEA LORD AND CHIEF OF NAVAL STAFF.

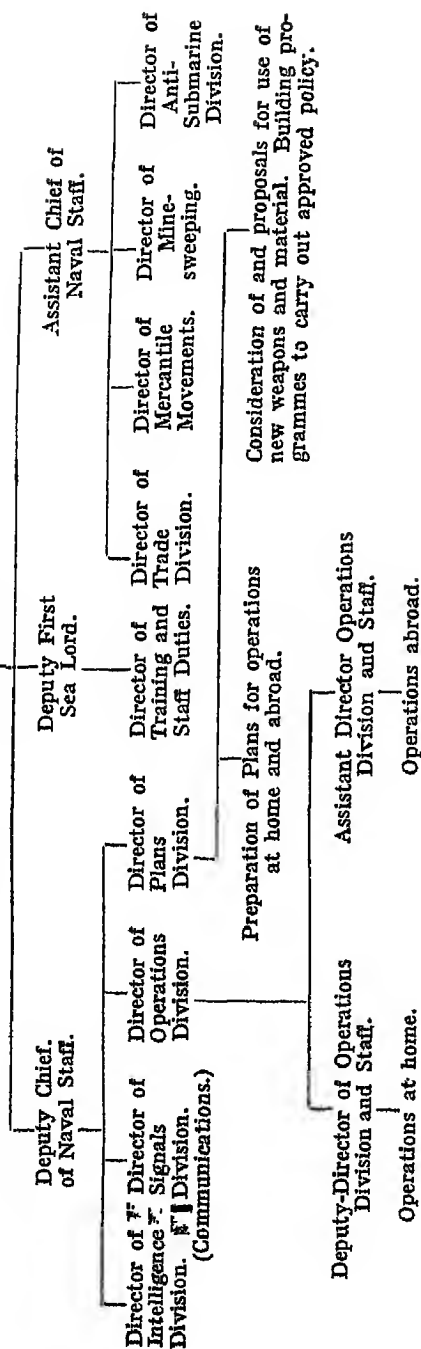
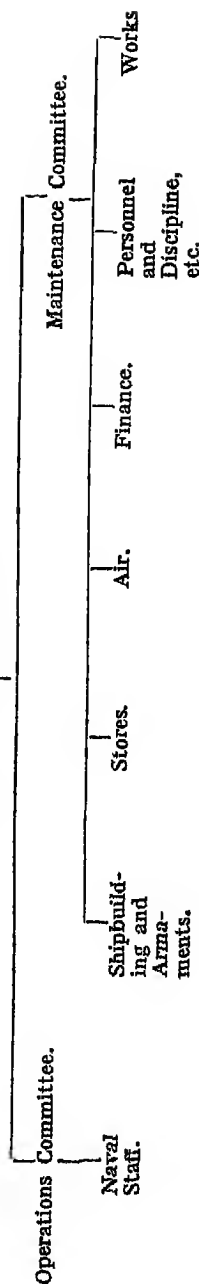


Table B

BOARD OF ADMIRALTY.



Early in 1918, after my departure from the Admiralty, the following announcement appeared in the Press :

The Secretary of the Admiralty makes the following announcement :—

The Letters Patent for the new Board of Admiralty having now been issued, it may be desirable to summarize the changes in the personnel of the Board and to indicate briefly the alterations in organization that have been decided upon.

Acting Vice-Admiral Sir Henry Oliver now brings to a close his long period of valuable service on the Naval Staff and will take up a sea-going command, being succeeded as D.C.N.S. by Rear-Admiral Sydney Fremantle. Rear-Admiral George P. W. Hope has been selected for the appointment of Deputy First Sea Lord, formerly held by Admiral Wemyss, but with changed functions. Commodore Paine, Fifth Sea Lord and Chief of Naval Air Service, leaves the Board of Admiralty in consequence of the recent creation of the Air Council, of which he is now a member, and formal effect is now given to the appointment of Mr. A. F. Pease as Second Civil Lord, which was announced on Thursday last.

In view of the formal recognition now accorded, as explained by the First Lord in his statement in the House of Commons on the 1st November, to the principle of the division of the work of the Board under the two heads of Operations and Maintenance, the Members of the new Board (other than the First Lord) may be grouped as follows :—

OPERATIONS.

First Sea Lord
and

Chief of Naval Staff.

(Admiral Sir Rosslyn Wemyss.)

Deputy Chief of Naval Staff.
(Rear-Admiral S. R. Fremantle.)

Assistant Chief of Naval Staff.
(Rear-Admiral A. L. Duff.)

MAINTENANCE.

Second Sea Lord.

(Vice-Admiral Sir H. L. Heath.)

Third Sea Lord.
(Rear-Admiral L. Halsey.)

Fourth Sea Lord.
(Rear-Admiral H. H. D.
Tothill.)

The Crisis of the Naval War

Deputy First Sea Lord. *Civil Lord.*
 (Rear-Admiral G. P. W. Hope.) (Right Hon. F. G. Pretyman,
 M.P.)

Controller.
 (Sir A. G. Anderson.)

Second Civil Lord.
 (Mr. A. F. Pease.)

Financial Secretary.
 (Right Hon. T. J. Macnamara, M.P.)

Permanent Secretary.
 (Sir O. Murray.)

The principle of isolating the work of planning and directing naval war operations from all other work, in order that it may receive the entire attention of the Officers selected for its performance, is now being carried a stage further and applied systematically to the organization of the Operations side of the Board and that of the Naval Staff.

In future the general distribution of duties between the Members of the Board belonging to the Naval Staff will be as follows :—

FIRST SEA LORD AND CHIEF OF NAVAL STAFF	Naval policy and general direction of operations.
DEPUTY CHIEF OF NAVAL STAFF	War operations in Home Waters.
ASSISTANT CHIEF OF NAVAL STAFF	Trade Protection and anti-submarine operations.
DEPUTY FIRST SEA LORD ..	General policy questions and operations outside Home Waters.

The detailed arrangements have been carefully worked out so as to relieve the first three of these officers of the necessity of dealing with any questions not directly connected with the main operations of the war, and the great mass of important paper work and administrative detail which is inseparably and necessarily connected with Staff work, but which has hitherto

tended to compete for attention with Operations work generally will under the new organization be diverted to the Deputy First Sea Lord.

The grouping of the Directors of the Naval Staff Divisions will be governed by the same principle.

The only two Directors that will work immediately under the First Sea Lord will be the Director of Intelligence Division (Rear-Admiral Sir Reginald Hall) and the Director of Training and Staff Duties (Rear-Admiral J. C. Ley), whose functions obviously affect all the other Staff Divisions alike.

Under the Deputy Chief of Naval Staff will be grouped three Directors whose duties will relate entirely to the planning and direction of operations in the main sphere of naval activity, viz. :—

Director of Operations Division Captain A. D. P. Pound.

(Home)

Director of Plans Division .. Captain C. T. M. Fuller,
C.M.G., D.S.O.

Director of Air Division .. Wing Captain F. R. Scarlett,
D.S.O.

together with the Director of Signals Division, Acting-Captain R. L. Nicholson, D.S.O., whose duties relate to the system of Fleet communications.

Under the Assistant Chief of Naval Staff will be grouped four Directors, whose duties relate to Trade Protection and Anti-Submarine Operations, viz. :—

Director of Anti-Submarine Division Captain W. W. Fisher, C.B.

Director of Mine-sweeping Division Captain L. G. Preston, C.B.

Director of Mercantile Movements Division Captain F. A. Whitehead.

Director of Trade Division .. Captain A. G. Hotham.

Under the Deputy First Sea Lord there will be one *Director of Operations Division (Foreign)*—Captain C. P. R. Coode, D.S.O.

The chief change on the Maintenance side of the Board relates to the distribution of duties amongst the Civil Members. The continuance of the war has caused a steady increase in the number of cases in which necessary developments of Admiralty policy due to the war, or experience resulting from war conditions give rise to administrative problems of great importance and complexity, of which a solution will have to be forthcoming either immediately upon or very soon after the conclusion of the war. The difficulty of concentrating attention on these problems of the future in the midst of current administrative work of great urgency may easily be appreciated, and the Civil Lord has consented to take charge of this important matter, with suitable naval and other assistance. He will, therefore, be relieved by the Second Civil Lord of the administration of the programme of Naval Works, including the questions of priority of labour and material requirements arising therefrom and the superintendence of the Director of Works Department.

It has further been decided that the exceptional labour and other difficulties now attending upon the execution of the very large programme of urgent naval works in progress have so greatly transformed the functions of the Director of Works Department of the Admiralty that it is desirable, whilst these abnormal conditions last, to place that Department under the charge of an expert in the rapid execution of large engineering works.

The Army Council have consented, at the request of the First Lord of the Admiralty, to lend for this purpose the services of Colonel Alexander Gibb, K.B.E., C.B., R.E., Chief Engineer, Port Construction, British Armies in France. Colonel Gibb (of the Firm of Easton, Gibb, Son and Company, which built Rosyth Naval Base) will have the title of Civil Engineer-in-Chief, and will be assisted by the Director of Works, who retains his status as such, and the existing Staff of the Department, which will be strengthened as necessary.

Another important change has reference to the organization of the Admiralty Board of Invention and Research, and has the object at once of securing greater concentration of effort

in connection with scientific research and experiment, and ensuring that the distinguished scientists who are giving their assistance to the Admiralty are more constantly in and amongst the problems upon which they are advising.

Mr. Charles H. Merz, M.Inst.C.E., the well-known Electrical Consulting Engineer, who has been associated with the Board of Invention and Research (B.I.R.) since its inception, has consented to serve as Director of Experiments and Research (unpaid) at the Admiralty to direct and supervise all the executive arrangements in connection with the organization of scientific Research and Experiments. Mr. Merz will also be a member of the Central Committee of the B.I.R. under the presidency of Admiral of the Fleet Lord Fisher. The functions of the Central Committee will, as hitherto, be to initiate, investigate, develop and advise generally upon proposals in respect to the application of Science and Engineering to Naval Warfare, but the distinguished scientific experts at present giving their services will in future work more much closely with the Technical Departments of the Admiralty immediately concerned with the production and use of apparatus required for specific purposes.

The general arrangements in regard to the organization of scientific research and experiment will in future come under the direct supervision of the First Lord.

Possibly by reason of the manner in which the announcement was made, the Press appeared to assume that the whole of this Admiralty organization was new. Such was not the case. Apart from the changes in the personnel of the Board itself and a slight rearrangement of their duties and those due to the establishment of an Air Ministry (which had been arranged by the Cabinet before December, 1917), there were but slight alterations in the organization shown in Table A, as will be seen by comparing it with Table C on p. 27, which indicates graphically the organization given in the Admiralty communiqué.

It will be seen that the alterations in Naval Staff organization were as follows :

(a) The new Deputy First Sea Lord—Rear-Admiral Hope—who since the spring of 1917 had been Director of the Operations Division, was given the responsibility for operations in foreign waters, with a Director of Operations (foreign) under him, and was also definitely charged with the administrative detail involving technical matters. The special gifts, experience and aptitude of this particular officer for such work enabled him, no doubt, to relieve the pressure on the First Sea Lord for administrative detail very materially.

(b) The Operations Division was separated into two parts (home and foreign), with a Director for each, instead of there being a Deputy Director for home and an Assistant Director for foreign work, both working under the Director. This was a change in name only, as the same officer continued the foreign work under the new arrangement.

(c) The Director of the Intelligence Division and the Director of Training and Staff Duties were shown as working immediately under the First Sea Lord and Chief of the Naval Staff.

(d) A Director of the Air Division was introduced as a result of the Naval Air Service having been separated from the Admiralty and placed under the Air Ministry. A larger Admiralty Staff organization for aerial matters thus became necessary, since the Staff could no longer refer to the Naval Air Service.

There were no other changes in the Staff organization. As regards the general Admiralty organization, there

was no change except that caused by the disappearance of the separate Naval Air Service, the addition of a Second Civil Lord, and some reorganization of the Board of Invention and Research which had been under discussion for some months previously.

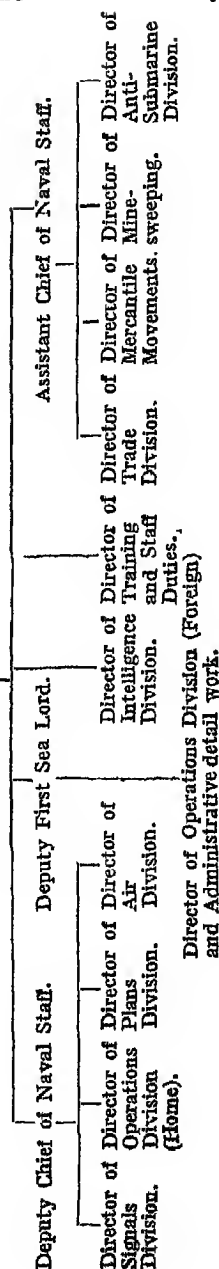
It is probable that in 1918 the Chief of the Naval Staff had more time at his disposal than was the case in 1917, owing to the changes in organization initiated in the later year having reached some finality and to the fact that the numerous anti-submarine measures put in hand in 1917 had become effective in 1918.

The future Admiralty Naval Staff organization, which was in my mind at the end of 1917, was a development of that shown in Table A, p. 20, subject to the following remarks:

In the organization then adopted the personality and experience during the war of many of the officers in high positions were of necessity considered, and the organization to that extent adapted to circumstances. This resulted in somewhat overloading the staff at the head, and the principle on which the Board of Admiralty

Table C

FIRST SEA LORD AND CHIEF OF NAVAL STAFF.



works, i.e., that its members are colleagues one of another, and seniority in rank does not, theoretically, give greater weight in council, was not altogether followed. Thus the Deputy Chief of the Naval Staff, the Assistant Chief of the Naval Staff, and the Deputy First Sea Lord were, by the nature of their duties, subordinate to the Chief of the Naval Staff and yet were members of the Board. The well-known loyalty of naval officers to one another tended to minimize any difficulties that might have arisen from this anomaly, but the arrangement might conceivably give rise to difficulty, and is best avoided if the Board system is to remain.

The situation would be clearer if two of the three officers concerned were removed altogether from the Board, viz., the Deputy First Sea Lord and the Assistant Chief of the Naval Staff, leaving only the Deputy Chief of the Naval Staff as a member of the Board to act in the absence of the Chief of the Naval Staff and to relieve him of the administrative and technical work not immediately connected with operations.

The work of the two officers thus removed should, under these conditions, be undertaken by officers who should preferably be Flag Officers, with experience in command at sea, having the titles of Directors of Operations, whose emoluments should be commensurate with their position and responsibilities.

I did not consider it advisable to carry out this alteration during the war, and it was also difficult under the hour to hour stress of war to rearrange all the duties of the Naval Staff in the manner most convenient to the conduct of Staff business, although its desirability was recognized during 1917.

It may be as well to close this chapter by a few remarks on Staff work generally in the Navy. In the first

place it is necessary in the Navy to give much weight to the opinions of specialist officers, and for this reason it is desirable that they should be included in the Staff organization, and not "attached" to it as was the case with our Army in pre-war days. The reason for this is that in the Army there is, except in regard to artillery, little "specialization." The training received by an officer of any of the fighting branches of the Army at the Staff College may fit him to assist in the planning and execution of operations, provided due regard is paid to questions of supply, transport, housing, etc.

This is not so in a navy. A ship and all that she contains is the weapon, and very intimate knowledge of the different factors that go to make a ship an efficient weapon is necessary if the ship is to be used effectively and if operations in which the ship takes so prominent a part are to be successfully planned and executed, or if a sound opinion is to be expressed on the training necessary to produce and maintain her as an efficient weapon.

The particular points in which this specially intimate knowledge is required are :

- (a) The science of navigation and of handling ships of all types and classes.
- (b) Gunnery.
- (c) Torpedoes and mines.

It is the case at present (and the conditions are not likely to alter) that each one of these subjects is a matter for specialist training. Every executive officer has a general knowledge of each subject, but it is not possible for any one officer to possess the knowledge of all three which is gained by the specialist, and if attempts are made to plan operations without the assistance of the specialists grave errors may be made, and, indeed, such

errors were made during the late war, perhaps from this cause.

In my view, therefore, it is desirable that specialist officers should be included in a Naval Staff organization and not be merely "attached" to it. It may be said that a Staff can take the advice of specialist officers who are *attached* to it for that purpose. But there is a danger that the specialist advice may never reach the heads of the Staff. Human nature being what it is, the safest procedure is to place the specialist officer where his voice must be heard, i.e. to give him a position on the Staff, for one must legislate for the average individual and for normal conditions of work.

The Chief of a Staff *might* have specialist knowledge himself, or he *might* assure himself that due weight had been given to the opinions of specialists attached to a Staff; but, on the other hand, it is possible that he might not have that knowledge and that he might ignore the opinions of the specialists. The procedure suggested is at least as necessary when considering the question of training as it is in the case of operations.

In passing from this point I may say that I have heard the opinion expressed by military Staff officers that the war has shown that artillery is so all important that it would be desirable to place the Major-General of the Royal Artillery, now *attached* to General Headquarters, on the Staff for operational matters.

Finally, great care should be exercised to prevent the Staff becoming larger than is necessary, and there is some danger that the ignorant may gauge the value of the Staff by its size.

Von Schellendorff says on this subject :

"The principle strictly followed throughout the German Service of reducing all Staffs to the smallest possible dimensions

is moreover vindicated by restricting every Staff to what is absolutely necessary, and by not attaching to every Army, Army Corps and Divisional Staff representatives of all the various branches and departments according to any fixed rule.

“There cannot be the slightest doubt that the addition of every individual not absolutely required on a Staff is in itself an evil. In the first place, it unnecessarily weakens the strength of the regiment from which an officer is taken. Again it increases the difficulty of providing the Staff with quarters, which affects the troops that may happen to be quartered in the same place; and these are quite ready enough, as it is, occasionally to look with a certain amount of dislike—though in most cases it is entirely uncalled for—on the personnel of the higher Staffs. Finally, it should be remembered—and this is the most weighty argument against the proceeding—that *idleness is at the root of all mischief*. When there are too many officers on a Staff they cannot always find the work and occupation essential for their mental and physical welfare, and their superfluous energies soon make themselves felt in all sorts of objectionable ways. Experience shows that whenever a Staff is unnecessarily numerous the ambitious before long take to intrigue, the litigious soon produce general friction, and the vain are never satisfied. These failings, so common to human nature, even if all present, are to a great extent counteracted if those concerned have plenty of hard and constant work. Besides, the numbers of a Staff being few, there is all the greater choice in the selection of the men who are to fill posts on it. In forming a Staff for war the qualifications required include not only great professional knowledge and acquaintance with service routine, but above all things character, self-denial, energy, tact and discretion.”

CHAPTER II

THE SUBMARINE CAMPAIGN IN THE EARLY PART OF 1917

THE struggle against the depredations of the enemy submarines during the year 1917 was two-fold; *offensive* in the direction of anti-submarine measures (this was partly the business of the Anti-Submarine Division of the Naval Staff and partly that of the Operations Division); *defensive* in the direction of protective measures for trade, whether carried in our own ships or in ships belonging to our Allies or to neutrals, this being the business of the Trade and Mercantile Movements Divisions.

Prior to the formation of the Mercantile Movements Division the whole direction of trade was in the hands of the Trade Division of the Staff.

The difficulty with which we were constantly faced in the early part of 1917, when the effective means of fighting the submarine were very largely confined to the employment of surface vessels, was that of providing a sufficient number of such vessels for *offensive* operations without incurring too heavy risks for our trade by the withdrawal of vessels engaged in what might be termed *defensive* work. There was always great doubt whether any particular offensive operation undertaken by small craft would produce any result, particularly as the numbers necessary for success were not available, whilst there was the practical *certainty* that withdrawal of defensive vessels would increase our losses; the situation was so serious in the spring of 1917 that we could not carry out experi-

Submarine Campaign: Early Part of 1917 33

ments involving grave risk of considerably increased losses.

On the other hand, the sinking of one enemy submarine meant the possible saving of a considerable number of merchant ships. It was difficult to draw the line between the two classes of operations.

The desire of the Anti-Submarine Division to obtain destroyers for offensive use in hunting flotillas in the North Sea and English Channel led to continual requests being made to me to provide vessels for the purpose. I was, of course, anxious to institute offensive operations, but in the early days of 1917 we could not rely much on depth-charge attack, owing to our small stock of these charges, and my experience in the Grand Fleet had convinced me that for success in the alternative of hunting submarines for a period which would exhaust their batteries and so force them to come to the surface, a large number of destroyers was required, unless the destroyers were provided with some apparatus which would, by sound or otherwise, locate the submarine. This will be realized when the fact is recalled that a German submarine could remain submerged at slow speed for a period which would enable her to travel a distance of some 80 miles. As this distance could be covered in any direction in open waters such as the North Sea, it is obvious that only a very numerous force of destroyers steaming at high speed could cover the great area in which the submarine might come to the surface. She would, naturally, select the dark hours for emergence, as being the period of very limited range of vision for those searching for her. In confined waters such as those in the eastern portion of the English Channel the problem became simpler. Requests for destroyers constantly came from every quarter, such as the Commanders-in-Chief at Portsmouth and Devon-

port, the Senior Naval Officer at Gibraltar, the Vice-Admiral, Dover, the Rear-Admiral Commanding East Coast, and the Admiral at Queenstown. The vessels they wanted did not, however, exist.

Eventually, with great difficulty, a force of six destroyers was collected from various sources in the spring of 1917, and used in the Channel solely for hunting submarines; this number was really quite inadequate, and it was not long before they had to be taken for convoy work.

Evidence of the difficulty of successfully hunting submarines was often furnished by the experiences of our own vessels of this type, sometimes when hunted by the enemy, sometimes when hunted in error by our own craft. Many of our submarines went through some decidedly unpleasant experiences at the hands of our own surface vessels and occasionally at the hands of vessels belonging to our Allies. On several such occasions the submarine was frequently reported as having been sunk, whereas she had escaped.

As an example of a submarine that succeeded not only in evading destruction, but in getting at least even with the enemy, the case of one of our vessels of the "E" class, on patrol in the Helligoland Bight, may be cited. This submarine ran into a heavy anti-submarine net, and was dragged, nose first, to the bottom. After half an hour's effort, during which bombs were exploding in her vicinity, the submarine was brought to the surface by her own crew by the discharge of a great deal of water from her forward ballast tanks. It was found, however, that the net was still foul of her, and that a Zeppelin was overhead, evidently attracted by the disturbance in the water due to the discharge of air and water from the submarine. She went to the bottom again, and after

Submarine Campaign: Early Part of 1917 35

half an hour succeeded in getting clear of the net. Meanwhile the Zeppelin had collected a force of trawlers and destroyers, and the submarine was hunted for fourteen hours by this force, assisted by the airship. During this period she succeeded in sinking one of the German destroyers, and was eventually left unmolested.

For a correct appreciation of submarine warfare it is necessary to have a clear idea of the characteristics and qualities of the submarine herself, of the numbers possessed by the enemy, and of the rate at which they were being produced. It is also necessary, in order to understand the difficulty of introducing the counter measures adopted by the Royal Navy, to know the length of time required to produce the vessels and the weapons which were employed or which it was intended to employ in the anti-submarine war.

The German submarines may be divided into four classes, viz.: Submarine cruisers, U-boats, U.B.-boats, U.C.-boats. There were several variations of each class.

The earlier *submarine cruisers* of the "Deutschland" class were double-hulled vessels, with a surface displacement of 1,850 tons, and were about 215 feet long; they had a surface speed of about 12 knots and a submerged speed of about 6 knots. They carried two 5.9-inch guns, two 22 pounders, two torpedo tubes, and 12 torpedoes. They could keep the sea for quite four months without being dependent on a supply ship or base.

The later *submarine cruisers* were double-hulled, 275-320 feet long, had a surface speed of 16-18 knots, and a submerged speed of about 7 to 8 knots. They carried either one or two 5.9-inch guns, six torpedo tubes, and about 10 torpedoes. They had a very large radius of action, viz., from 12,000 to 20,000 miles, at a speed of 6 knots. A large number (some 30 to 40) of these boats

were under construction at the time of the Armistice, but very few had been completed.

There were two or three types of *U-boats*. The earlier vessels were 210 to 220 feet long, double-hulled, with a surface displacement of about 750 tons, a surface speed of 15 to 16 knots, and a submerged speed of about 8 knots. They carried one or two 4.1-inch guns, four to six torpedo tubes, and about 10 torpedoes.

Later vessels of the class were 230 to 240 feet long, and of 800 to 820 tons surface displacement, and carried six torpedo tubes and 16 torpedoes. Some of them, fitted as minelayers, carried 36 mines, and two torpedo tubes, but only two torpedoes. A later and much larger class of minelayers carried a 5.9-inch gun, four torpedo tubes, 42 mines, and a larger number of torpedoes. The earlier *U-boats* could keep the sea for about five weeks without returning to a base or a supply ship; the later *U-boats* had much greater sea endurance.

The smaller *U.B.-boats* were single-hulled, and about 100 feet long, had a surface speed of 7 to 9 knots and a submerged speed of about 5 knots, and carried one 22-pounder gun, two torpedo tubes and four torpedoes. These boats could keep the sea for about two weeks without returning to a base or supply ship. A later class were double-hulled, 180 feet long, with greater endurance (8,000 miles at 6 knots), a surface speed of 13 knots and a submerged speed of 8 knots; they carried one 4.1-inch gun, five tubes and 10 torpedoes.

The earliest *U.C.-boats* were 111 feet long, with a surface displacement of 175 tons, a surface speed of $6\frac{1}{2}$ knots, and a submerged speed of 5 knots. They carried 12 mines, but no torpedo tubes, and as they had a fuel endurance of only 800 miles at $5\frac{1}{2}$ knots, they could operate only in southern waters.

Submarine Campaign: Early Part of 1917 37

The later *U.C.-boats* were 170 to 180 feet long, double-hulled, had a surface speed of 11 to 12 knots and a submerged speed of about 7 knots, carried 18 mines, three torpedo tubes, five torpedoes, and one 22-pounder gun, and their fuel endurance was 8,000 to 10,000 miles at a speed of 7 to 8 knots.

At the end of February, 1917, it was estimated that the enemy had a total of about 130 submarines of all types available for use in home waters, and about 20 in the Mediterranean. Of this total an average of between one-half and one-third was usually at sea. During the year about eight submarines, on the average, were added monthly to this total. Of this number some 50 per cent. were vessels of the mine-laying type.

All the German submarines were capable of prolonged endurance submerged. The *U-boats* could travel under water at the slowest speed for some 48 hours, at about 4 knots for 20 hours, at 5 knots for about 12 hours, and at 8 knots for about 2 hours.

They were tested to depths of at least 180 feet, but many submerged to depths exceeding 250 feet without injury. They did not usually lie on the bottom at depths greatly exceeding 20 fathoms (120 feet).

All German submarines, except possibly the *cruiser class*, could dive from diving trim in from 30 seconds to one minute. The *U.B. class* had particularly rapid diving qualities, and were very popular boats with the German submarine officers. Perhaps the most noticeable features of the German submarines as a whole were their excellent engines and their great strength of construction.

Prior to the month of February, 1917, it was the usual practice of the enemy submarine in the warfare against merchant ships to give some warning before delivering her attack. This was by no means a universal

rule, particularly in the case of British merchant vessels, as is evidenced by the attacks on the *Lusitania*, *Arabic*, and scores of other ships.

In the years 1915 and 1916, however, only 21 and 29 per cent. respectively of the British merchant ships sunk by enemy submarines were destroyed without warning, whilst during the first four months of the unrestricted submarine warfare in 1917 the figure rose to 64 per cent., and went higher and higher as the months progressed.

Prior to February, 1917, the more general method of attack on ships was to "bring them to" by means of gun-fire; they were then sunk by gun-fire, torpedo, or bomb. This practice necessitated the submarine being on the surface, and so gave a merchant ship defensively armed a chance of replying to the gun-fire and of escaping, and it also gave armed decoy ships a good opportunity of successful action if the submarine could be induced to close to very short range.

The form of attack on commerce known as "unrestricted submarine warfare" was commenced by Germany with the object of forcing Great Britain to make peace by cutting off her supplies of food and raw material. It has been acknowledged by Germans in high positions that the German Admiralty considered that this form of warfare would achieve its object in a comparatively short time, in fact in a matter of some five or six months.

Experienced British naval officers, aware of the extent of the German submarine building programme, and above all aware of the shadowy nature of our existing means of defence against such a form of warfare, had every reason to hold the view that the danger was great and that the Allies were faced with a situation fraught with the very gravest possibilities.

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The principal doubt was as to the ability of the enemy to train submarine crews with sufficient rapidity to keep pace with his building programme.

However, it was ascertained that the Germans had evidently devoted a very great number of their submarines to training work during the period September, 1915, to March, 1916, possibly in anticipation of the unrestricted warfare, since none of their larger boats was operating in our waters between these months; this fact had a considerable bearing on the problem.

As events turned out it would appear either that the training given was insufficient or that the German submarine officer was lacking in enterprise.

There is no doubt whatever that had the German craft engaged in the unrestricted submarine warfare been manned by British officers and men, adopting German methods, there would have been but few Allied or neutral merchant ships left afloat by the end of 1917.

So long as the majority of the German submarine attacks upon shipping were made by gun-fire, the method of defence was comparatively simple, in that it merely involved the supply to merchant ships of guns of sufficient power to prevent the submarine engaging at ranges at which the fire could not be returned. Whilst the *method* of defence was apparent, the problem of *supplying* suitable guns in sufficient numbers was a very different matter. It involved arming all our merchant ships with guns of 4-inch calibre and above. In January, 1917, only some 1,400 British ships had been so armed since the outbreak of war.

It will be seen, therefore, that so long as ships sailed singly, very extensive supplies of guns were required to meet gun attack, and as there was most pressing need for the supply of guns for the Army in France, as well

as for the anti-aircraft defence of London, the prospect of arming merchant ships adequately was not promising.

When the enemy commenced unrestricted submarine warfare attack by gun-fire was gradually replaced by attack by torpedo, and the problem at once became infinitely more complicated.

Gun-fire was no longer a protection, since the submarine was rarely seen. The first intimation of her presence would be given by the track of a torpedo coming towards the ship, and no defence was then possible beyond an endeavour to manœuvre the ship clear of the torpedo. Since, however, a torpedo is always some distance ahead of the bubbles which mark its track (the speed of the torpedo exceeding 30 knots an hour), the track is not, as a rule, seen until the torpedo is fairly close to the ship unless the sea is absolutely calm. The chance of a ship of low speed avoiding a hit by a timely alteration of course after the torpedo has been fired is but slight. Further, the only difficulty experienced by a submarine in hitting a moving vessel by torpedo-fire, once she has arrived in a position suitable for attack, lies in estimating correctly the course and speed of the target. In the case of an ordinary cargo ship there is little difficulty in guessing her speed, since it is certain to be between 8 and 12 knots, and her course can be judged with fair accuracy by the angle of her masts and funnel, or by the angle presented by her bridge.

It will be seen, then, how easy was the problem before the German submarine officers, and how very difficult was that set to our Navy and our gallant Mercantile Marine.

It will not be out of place here to describe the methods which were in force at the end of 1916 and during the first part of 1917 for affording protection to merchant

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shipping approaching our coasts from the direction of the Atlantic Ocean.

The general idea dating from the early months of the war was to disperse trade on passage over wide tracts of ocean, in order to prevent the successful attacks which could be so easily carried out if shipping traversed one particular route. To carry out such a system it was necessary to give each vessel a definite route which she should follow from her port of departure to her port of arrival; unless this course was adopted, successive ships would certainly be found to be following identical, or practically identical, routes, thereby greatly increasing the chance of attack. In the early years of the war masters of ships were given approximate tracks, but when the unrestricted submarine campaign came into being it became necessary to give exact routes.

The necessary orders were issued by officers stationed at various ports at home and abroad who were designated Shipping Intelligence or Reporting Officers. It was, of course, essential to preserve the secrecy of the general principles governing the issue of route orders and of the route orders themselves. For this reason each master was only informed of the orders affecting his own ship, and was directed that such orders should on no account fall into the hands of the enemy.

The route orders were compiled on certain principles, of which a few may be mentioned:

(a) Certain definite positions of latitude and longitude were given through which the ship was required to pass, and the orders were discussed with the master of each vessel in order to ensure that they were fully understood.

(b) Directions were given that certain localities

in which submarines were known to operate, such as the approaches to the coast of the United Kingdom, were, if possible, to be crossed at night. It was pointed out that when the speed of the ship did not admit of traversing the whole danger area at night, the portion involving the greatest danger (which was the inshore position) should, as a rule, be crossed during dark hours.

(c) Similarly the orders stated that ships should, as a rule, leave port so as to approach the dangerous area at dusk, and that they should make the coast at about daylight, and should avoid, as far as possible, the practice of making the land at points in general use in peace time.

(d) Orders were definite that ships were to zigzag both by day and at night in certain areas, and if kept waiting outside a port.

(e) Masters were cautioned to hug the coast, as far as navigational facilities admitted, when making coastal passages.

The orders (b), (c) and (d) were those in practice in the Grand Fleet when circumstances permitted during my term in that command.

A typical route order from New York to Liverpool might be as follows :

“ After passing Sandy Hook, hug the coast until dark, then make a good offing before daylight and steer to pass through the following positions, viz :

Lat. 38° N.	Long. 68° W.
Lat. 41° N.	Long. 48° W.
Lat. 46° N.	Long. 28° W.
Lat. 51° 30' N.	Long. 14° W.

“ Thence make the coast near the Skelligs approxi-

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mately at daylight, hug the Irish coast to the Tuskar, up the Irish coast (inside the banks if possible), and across the Irish Channel during dark hours. Thence hug the coast to your port; zigzag by day and night after passing Long. 20° W."

Sometimes ships were directed to cross to the English coast from the south of Ireland, and to hug the English coast on their way north.

The traffic to the United Kingdom was so arranged in the early part of 1917 as to approach the coast in four different areas, which were known as Approach A, B, C, and D.

Approach A was used for traffic bound towards the western approach to the English Channel.

Approach B for traffic making for the south of Ireland.

Approach C for traffic making for the north of Ireland.

Approach D for traffic making for the east coast of England via the north of Scotland.

The approach areas in force during one particular period are shown on Chart A (in pocket at the end of the book). They were changed occasionally when suspicion was aroused that their limits were known to the enemy, or as submarine attack in an area became intense.

The approach areas were patrolled at the time, so far as numbers admitted, by patrol craft (trawlers, torpedo-boat destroyers, and sloops), and ships with specially valuable cargoes were given directions to proceed to a certain rendezvous on the outskirts of the area, there to be met by a destroyer or sloop, if one was available for the purpose. The areas were necessarily of considerable

length, by reason of the distance from the coast at which submarines operated, and of considerable width, owing to the necessity for a fairly wide dispersion of traffic throughout the area. Consequently, with the comparatively small number of patrol craft available, the protection afforded was but slight, and losses were correspondingly heavy. In the early spring of 1917, Captain H. W. Grant, of the Operations Division at the Admiralty, whose work in the Division was of great value, proposed a change in method by which the traffic should be brought along certain definite "lines" in each approach area. Typical lines are shown in Chart B.

The idea was that the traffic in, say, Approach Route B, should, commencing on a certain date, be ordered by the Routeing Officer to pass along the line Alpha. Traffic would continue along the line for a certain period, which was fixed at five days, when it would be automatically diverted to another line, say Gamma, but the traffic along Gamma would not commence until a period of 24 hours had elapsed since discontinuance of the use of the line Alpha. This was necessary in order to give time for the patrol craft to change from one line to the other. During this period of 24 hours the arrangement for routeing at the ports of departure ensured that no traffic would reach the outer end of any of the approach lines, and consequently that traffic would cease on line Alpha 24 hours before it commenced on line Gamma. After a further period of five days the line would again change automatically.

It was necessary that Shipping Intelligence Officers should have in their possession the orders for directing traffic on to the various lines for some considerable time ahead, and the masters of ships which were likely to be for some time at sea were informed of the dates between

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which the various lines were to be used, up to a date sufficient to cover the end of their voyage. There was, therefore, some danger of this information reaching the enemy if a vessel were captured by a submarine and the master failed to destroy his instructions in time. There was also some danger in giving the information to neutrals.

However, the system, which was adopted, did result in a reduction of losses during the comparatively short time that it was in use, and the knowledge that patrol craft on the line would be much closer together than they would be in an approach area certainly gave confidence to the personnel of the merchant ships, and those who had been forced to abandon their ship by taking to the boats were afforded a better chance of being picked up.

Various arrangements were in existence for effecting rapidly a diversion of shipping from one route to another in the event of submarines being located in any particular position, and a continual change of the signals for this purpose was necessary to guard against the possibility of the code being compromised by having fallen into enemy hands, an event which, unfortunately, was not infrequent.

Elaborate orders were necessary to regulate coastal traffic, and fresh directions were continually being issued as danger, especially danger from mines, was located. Generally speaking, the traffic in home waters was directed to hug the coast as closely as safe navigation permitted. Two reasons existed for this, (a) in water of a depth of less than about eight fathoms German submarines did not care to operate, and (b) under the procedure indicated danger from submarine attack was only likely on the side remote from the coast.

Here is an example of the instructions for passing up Channel :

From Falmouth to Portland Bill.—Hug the coast, following round the bays, except when passing Torbay. (Directions followed as to the procedure here.)

From Portland Bill to St. Catherines.—Pass close south of the Shaumbles and steer for Anvil Point, thence hug the coast, following round the bays.

And so on.

As it was not safe navigationally to follow round the bays during darkness, the instructions directed that ships were to leave the daylight route at dusk and to join the dark period route, showing dimmed bow lights whilst doing so.

Two "dark period routes" were laid down, one for vessels bound up Channel, and another for vessels bound down Channel, and these routes were some five miles apart in order to minimize the danger of collision, ships being directed not to use their navigation lights except for certain portions of the route, during which they crossed the route of transports and store ships bound between certain southern British ports (Portsmouth, Southampton and Devonport) and French ports.

Routes were similarly laid down for ships to follow when navigating to or from the Bristol Channel, and for ships navigating the Irish Sea.

Any system of convoy was at this time out of the question, as neither the cruisers to marshal the convoy to the submarine area, nor the destroyers to screen it when there, were available.

There was one very important factor in the situation, viz., the comparative rate at which the Germans could produce submarines and at which we could build vessels suitable for anti-submarine warfare and for defence of commerce. The varying estimates gave cause for grave

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anxiety. Our average output of *destroyers* was four to five per month. Indeed, this is putting the figure high; and, of course, we suffered losses. The French and Italians were not producing any vessels of this type, whilst the Japanese were, in the early part of 1917, not able to spare any for work in European waters, although later in the year they lent twelve destroyers, which gave valuable assistance in the Mediterranean. The United States of America were not then in the war. Consequently measures for the defence of the Allied trade against the new menace depended on our own production.

Our *submarines* were being produced at an average rate of about two per month only, and—apart from motor launches, which were only of use in the finest weather and near the coast—the only other vessels suitable for anti-submarine work that were building at the time, besides some sloops and P-boats, were trawlers, which, whilst useful for protection patrol, were too slow for most of the escort work or for offensive duties. The Germans' estimate of their own submarine production was about twelve per month, although this figure was never realized, the average being nearer eight. But each submarine was capable of sinking many merchant ships, thus necessitating the employment of a very large number of our destroyers; and therein lay the gravity of the situation, as we realized at the Admiralty early in 1917 that no effort of ours could increase the output of destroyers for at least fifteen months, the shortest time then taken to build a destroyer in this country.

And here it is interesting to compare the time occupied in the production of small craft in Great Britain and in Germany during the war.

In pre-war days we rarely built a destroyer in less

than twenty-four months, although shortly before the war efforts were made to reduce the time to something like eighteen to twenty months. Submarines occupied two years in construction.

In starting the great building programme of destroyers and submarines at the end of 1914, Lord Fisher increased very largely the number of firms engaged in constructing vessels of both types. Hopes were held out of the construction both of destroyers and of submarines in about twelve months; but labour and other difficulties intervened, and although some firms did complete craft of both classes during 1915 in less than twelve months, by 1916 and 1917 destroyers *averaged* about eighteen months and submarines even longer for completion.

The Germans had always built their small craft rapidly, although their heavy ships were longer in construction than our own. Their destroyers were completed in a little over twelve months from the official date of order in pre-war days. During the early years of the war it would seem that they maintained this figure, and they succeeded in building their smaller submarines of the U.B. and U.C. types in some six to eight months, as U.B. and U.C. boats began to be delivered as early as April, 1915, and it is certain that they were not ordered before August, 1914.

The time taken by the Germans to build submarines of the U type was estimated by us at twelve months, and that of submarine cruisers at eighteen months. German submarine officers gave the time as eight to ten months for a U-boat and eighteen months for a submarine cruiser.*

* It is to be observed that Captain Persius in a recent article gives a much longer period for the construction of the German submarines. It is not stated whether he had access to official figures, and his statement is not in agreement with the figures given by German submarine officers.



A German Submarine of the U-C Type (Minelayer).



A German Submarine of the later Cruiser Class.

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It is of interest to note here the rate of ship production attained by some firms in the United States of America during the war.

As I mention later,* the Bethlehem Steel Company, under Mr. Schwab's guidance, produced ten submarines for us in five months from the date of the order. Mr. Schwab himself informed me that towards the end of the war he was turning out large destroyers in six weeks. The Ford Company, as is well known, produced submarine chasers of the "Eagle" type in even a shorter period, but these vessels were of special design and construction.

I have dealt so far with the question of anti-submarine measures involving only the use of destroyers and other small surface craft. There were, of course, other methods both in use and under consideration early in 1917 when we took stock of the situation.

For some time we had been using *Decoy vessels*, and with some success; it was possible to increase the number of these ships at the cost of taking merchant ships off the trade routes or by building. A very considerable increase was arranged.

The use of our own *submarines* offensively against enemy submarines had also been tried, and had met with occasional success, but our numbers were very limited (the total in December, 1916, fit for oversea or anti-submarine work was about forty). They were much needed for reconnaissance and offensive work against surface men-of-war in enemy waters, and only a few were at the time available for anti-submarine operations, and then only at the cost of other important services.

The *hydrophone* had been in the experimental stage and under trial for a considerable period, but it had not

* *Vide* Chapter VI, p. 157.

so far developed into an effective instrument for locating submarines, and although trials of the different patterns which had been devised were pushed forward with energy, many months elapsed before it became a practicable proposition.

One of the best offensive measures against the enemy submarines, it was realized, was the *mine*, if laid in sufficiently large numbers. Unfortunately, in January, 1917, we did not possess a mine that was satisfactory against submarines.

Our deficiency in this respect was clearly shown in the course of some trials which I ordered, when one of our own submarines was run against a number of our mines, with the result that only about 33 per cent. of the mines (fitted, of course, only with small charges) exploded. The Germans were well aware that our mines were not very effective against submarines.

We possessed at the time mines of two patterns, and whilst proving unsatisfactory against submarines, they were also found to be somewhat unreliable when laid in minefields designed to catch surface vessels, owing to a defect in the mooring apparatus. This defect was remedied, but valuable time was lost whilst the necessary alterations were being carried out, and although we possessed in April, 1917, a stock of some 20,000 mines, only 1,500 of them were then fit for laying. The position, therefore, was that our mines were not a satisfactory anti-submarine weapon.

A *new pattern mine*, which had been designed on the model of the German mine during Sir Henry Jackson's term of office as First Sea Lord in 1916, was experimented with at the commencement of 1917, and as soon as drawings could be prepared orders for upwards of 100,000 were placed in anticipation of its success. There

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were some initial difficulties before all the details were satisfactory, and, in spite of the greatest pressure on manufacturers, it was not until November, 1917, that mines of this pattern were being delivered in large numbers. The earliest minefields laid in the Heligoland Bight in September and October, 1917, with mines of the new pattern met with immediate success against enemy submarines, as did the minefields composed of the same type of mine, the laying of which commenced in November, 1917, in the Straits of Dover.

When it became possible to adopt the system of bringing merchant ships in convoys through the submarine zone under the escort of a screen of destroyers, this system became in itself, to a certain extent, an offensive operation, since it necessarily forced the enemy submarines desirous of obtaining results into positions in which they themselves were open to violent attack by depth charges dropped by destroyers.

During the greater part of the year 1917, however, it was only possible to supply destroyers with a small number of *depth charges*, which was their principal anti-submarine weapon; as it became feasible to increase largely the supply of these charges to destroyers, so the violence of the attack on the submarines increased, and their losses became heavier.

The position then, as it existed in the early days of the year 1917, is described in the foregoing remarks.

The *result* measured in loss of shipping (British, Allied, and neutral) from submarine and mine attack in the first half of the year was as follows in gross tonnage :

January	...	324,016	April	...	870,859
February	...	500,578	May	...	589,754
March	...	555,991	June	...	675,154

Because of the time required for production, it was a sheer impossibility to *put into effect* any fresh devices that might be adopted for dealing with submarine warfare for many months, and all that could be done was to try new methods of approach to the coast and, as the number of small craft suitable for escort duty increased, to extend gradually the convoy system already in force to a certain extent for the French coal trade and the Scandinavian trade.

In the chapters which follow the further steps which were taken to deal with the problem, and the degree of success which attended them, will be described.

CHAPTER III

ANTI-SUBMARINE OPERATIONS

THE previous chapters have dealt with the changes in organization carried out at the Admiralty during the year 1917 largely with the object of being able to deal more effectively with the submarine warfare against merchant ships. Mention has also been made of the submarine problem with which the Navy had to deal; particulars of the anti-submarine and other work carried out will now be examined.

A very large proportion of the successful anti-submarine devices brought into use during 1917, and continued throughout the year 1918, were the outcome of the work of the Anti-Submarine Division of the Naval Staff, and it is but just that the high value of this work should be recognized when the history of the war comes to be written by future historians. As has been stated in Chapter I, Rear-Admiral A. C. Duff, C.B., was the original head of the division, with Captain F. C. Dreyer, C.B., Commander Yeats Brown, and Commander Reginald Henderson as his immediate assistants. Captain H. T. Walwyn took the place of Captain Dreyer on March 1, 1917, when the latter officer became Director of Naval Ordnance. When Admiral Duff was appointed Assistant Chief of the Naval Staff, with a seat on the Board, in May, 1917, Captain W. W. Fisher, C.B., became head of the division, which still remained one of the divisions of the Staff working immediately

under the A.C.N.S. It is to these officers, with their most zealous, clever and efficient staff, that the institution of many of the successful anti-submarine measures is largely due. They were indefatigable in their search for new methods and in working out and perfecting fresh schemes, and they kept their minds open to *new ideas*. They received much valuable assistance from the great civilian scientists who gave such ready help during the war, the function of the naval officers working with the scientists being to see that the effort was being directed along practical lines. They were also greatly indebted to Captain Ryan, R.N., for the exceedingly valuable work carried out by him at the experimental establishment at Hawkeraig. Many brilliant ideas were due to Captain Ryan's clever brain.

I doubt whether the debt due to Admiral Duff and Captain Fisher and their staff for their great work can ever be thoroughly appreciated, but it is certainly my duty to mention it here since I am better able to speak of it than any other person. In saying this I do not wish to detract in the least from the value of the part performed by those to whose lot it fell to put the actual schemes into operation. Without them, of course, nothing could have been accomplished.

When the Anti-Submarine Division started in December, 1916, the earlier devices to which attention was devoted were:

- (1) The design and manufacture of howitzers firing shell fitted to explode some 40 to 60 feet under water with which to attack submarines when submerged.

- (2) The introduction of a more suitable projectile for use against submarines than that supplied

at the time to the guns of destroyers and patrol craft.

(3) The improvement of and great increase in the supply of smoke apparatus for the screening of merchant ships from submarines attacking by gunfire.

(4) A great increase in the number of depth charges supplied to destroyers and other small craft.

(5) The development of the hydrophone for anti-submarine work, both from ships and from shore stations.

(6) The introduction of the "Otter" for the protection of merchant ships against mines.

(7) A very great improvement in the rapidity of arming merchant ships defensively.

(8) The extended and organized use of air craft for anti-submarine work.

(9) A great development of the special service or decoy ship.

(10) The introduction of a form of net protection for merchant ships against torpedo fire.

Other devices followed, many of which were the outcome of work in other Admiralty Departments, particularly the Departments of the Director of Naval Ordnance and the Director of Torpedoes and Mines, working in conjunction with the Anti-Submarine or the Operations Division of the Naval Staff. Some of the new features were the development of depth-charge throwers, the manufacture and use of fast coastal motor-boats for anti-submarine work, the production of mines of an improved type for use especially against submarines, very considerable developments in the use

of minefields, especially deep minefields, including persistent mining in the Heligoland Bight and the laying of a complete minefield at varying depths in the Straits of Dover; also, after the United States entered the war, the laying of a very extensive minefield right across the northern part of the North Sea. The provision of "flares" for illuminating minefields at night, and a system of submarine detection by the use of electrical apparatus were also matters which were taken up and pressed forward during 1917. During the year the system of dazzle painting for merchant ships was brought into general use.

On the operational side of the Naval Staff the work of dealing with enemy submarines before they passed out of the North Sea was taken in hand by organized hunting operations by destroyers and other patrol craft, and by the more extended use offensively of our own submarines, as vessels became available.

Considerable developments were effected in the matter of the control of mercantile traffic, and much was done to train the personnel of the mercantile marine in matters relating to submarine warfare.

Taking these subjects in detail, it will be of interest to examine the progress made during the year.

Howitzers

The *howitzer* as a weapon for use against the submarine when submerged was almost non-existent at the beginning of 1917, only thirty bomb-throwers, on the lines of trench-mortars, being on order. By April of that year designs for seven different kinds of bomb-throwers and howitzers had been prepared and approved, and orders placed for 1,006 weapons, of which number the first 41 were due for delivery in May. By the end

of May the number of bomb-throwers and howitzers on order had been increased to 2,056, of eight different patterns. Over 1,000 of these weapons fired a bomb or shell carrying a burster exceeding 90 lbs. in weight, and with a range varying between 1,200 and 2,600 yards. Later in the war, as we gained experience of the value of this form of attack, heavier bombs were introduced for use in the existing bomb-throwers and howitzers. The howitzer as an anti-submarine weapon was handicapped by the comparatively small weight of the bursting charge of its shell. This applied more particularly to the earlier patterns, and to inflict fatal injury it was necessary to burst the shell in close proximity to the submerged submarine. This weapon, although not very popular at first, soon, however, proved its value, when employed both from patrol craft and from merchant ships.

One curious instance occurred on March 28, 1918, of a merchant ship being saved by a 7.5-inch howitzer. A torpedo was seen approaching at a distance of some 600 yards, and it appeared certain to hit the ship. A projectile fired from the howitzer exploded under water close to the torpedo, deflected it from its course, and caused it to come to the surface some 60 yards from the ship; a second projectile caused it to stop, and apparently damaged the torpedo, which when picked up by an escorting vessel was found to be minus its head.

Delivery of howitzers commenced in June, 1917, and continued as follows :

<i>Date.</i>	<i>No. of Howitzers actually issued.</i>			<i>Total completed, including those under proof.</i>	
July 24, 1917	85	...	48
October 1, 1917	92	...	167
December 10, 1917	377	...	422

The slow rate of delivery, in spite of constant pressure, which is shown by these figures gives some idea of the time required to bring new devices into existence.

Projectile for Use Against Submarines

In January, 1917, the Director of Naval Ordnance was requested by the Anti-Submarine Division of the Naval Staff to carry out trials against a target representing the hull of a German submarine, so far as the details were known to us, to ascertain *the most suitable type of projectile* amongst those then in existence for the attack of submarines by guns of 4.7-inch calibre and below.

The results were published to the Fleet in March, 1917. They afforded some useful knowledge and demonstrated the ineffectiveness of some of the shells and fuses commonly in use against submarines from 12-pounder guns, the weapon with which so many of our patrol craft were armed. The target at which the shell was fired did not, however, fully represent a German submarine under the conditions of service. The trials were therefore continued, and as a result, in June, 1917, a further order was issued to the Fleet, giving directions as to the type of projectile to be used against submarines from all natures of guns, pending the introduction of delay action fuses for the smaller guns; this was the temporary solution of the difficulty until a new type of shell evolved from the experience gained at the trials could be produced and issued. The trials, which were exhaustive, were pressed forward vigorously and continuously throughout the year 1917, and meanwhile more accurate information as to the exact form of the hull and the thickness of the plating of German submarines became

available. Early in 1918 the first supplies of the new fuses were ready for issue.

Smoke Apparatus

The earlier *smoke apparatus* for supply to merchant ships was designed towards the end of 1916.

One description of smoke apparatus consisted of an arrangement for burning phosphorus at the stern of a ship; in other cases firework composition and other chemicals were used. A dense smoke cloud was thus formed, and, with the wind in a suitable direction, a vessel could hide her movements from an enemy submarine or other vessel, and thus screen herself from accurate shell fire.

In another form the apparatus was thrown overboard and formed a smoke cloud on the water.

The rate of supply of sets of the smoke apparatus to ships is shown by the following figures :

April 1, 1917	...	...	1,872 sets
July 8, 1917	...	...	2,563 ,,
October 5, 1917	...	...	3,445 ,,
November 26, 1917	...	...	3,976 ,,

Depth Charges

Depth charges, as supplied to ships in 1917, were of two patterns: one, Type D, contained a charge of 800 lb. of T.N.T., and the other, Type D*, carried 120 lb. of T.N.T. At the commencement of 1917 the allowance to ships was two of Type D and two of Type D*, and the supply was insufficient at that time to keep up the stock required to maintain on board four per destroyer, the number for which they were fitted, or to supply all trawlers and other patrol craft with their allowance. The great value of the depth charge as a weapon against sub-

marines, and the large number that were required for successful attack, became apparent early in 1917, and the allowance was increased. Difficulty was experienced throughout the year in maintaining adequate stocks owing to the shortage of labour and the many demands on our industries made by the war, but the improvement is shown by the fact that while the average output *per week* of depth charges was only 140 in July, it had become over 500 by October, and that by the end of December it was raised to over 800, and was still increasing very rapidly. As a consequence, early in 1918 it was found possible to increase the supply very largely, as many as 30 to 40 per destroyer being carried.

Improvements in the details of depth charges were effected during 1917. One such improvement was the introduction of a pistol capable of firing at much greater depths than had been in use before. The result was that all vessels, whether fast or slow, could safely use the 300-lb. depth charge if set to a sufficient depth. This led to the abolition of the Type D* charges and the universal supply of Type D.

In spite of the difficulties of dropping depth charges so close to submarines as to damage them sufficiently to cause them to come to the surface, very good results were obtained from their use when destroyers carried enough to form, so to speak, a ring round the assumed position at which the submarine had dived. In order to encourage scientific attack on submarines, a system of depth charge "Battle Practice" was introduced towards the end of 1917.

It is as well to correct a common misapprehension as to the value of depth charges in destroying submarines.

Many people held very exaggerated ideas on this subject, even to the extent of supposing that a depth

charge would destroy a submarine if dropped within several hundred yards of her. This is, unfortunately, very far indeed from being the case; it is, on the contrary, necessary to explode the charge near the submarine in order to effect destruction. Taking the depth charge with 300 lb. weight of explosive, ordinarily supplied to destroyers in 1917, it was necessary to explode it within fourteen feet of a submarine to ensure destruction; at distances up to about twenty-eight feet from the hull the depth charge might be expected to disable a submarine to the extent of forcing her to the surface, when she could be sunk by gun-fire or rammed, and at distances up to sixty feet the moral effect on the crew would be considerable and *might* force the submarine to the surface.

A consideration of these figures will show that it was necessary for a vessel attacking a submarine with depth charges to drop them in very close proximity, and the first obvious difficulty was to ascertain the position of a submarine that had dived and was out of sight.

Unless, therefore, the attacking vessel was fairly close to the submarine at the moment of the latter diving there was but little chance of the attack being successful.

Hydrophones

The *Hydrophone*, for use in locating submerged submarines, although first evolved in 1915, was in its infancy, so far as supply to ships was concerned, at the commencement of 1917. Experiments were being carried out by the Board of Invention and Research at Harwich, and by Captain Ryan, R.N., at Hawkeraig, and although very useful results had been obtained and a considerable number of shore stations as well as some patrol vessels had been fitted with hydrophones, which had a listening range of

one or two miles, all the devices for use afloat suffered from the disadvantage that it was not possible to use them whilst the ship carrying them was moving, since the noise of the vessel's own machinery and of the water passing along the side prevented the noise made by other vessels being located. What was required was a listening instrument that could be used by a ship moving at least at slow speed, otherwise the ship carrying the hydrophone was herself, when stopped, an easy target for the submarine's torpedo. It was also essential, before an attack could be delivered, to be able to locate the *direction* of the enemy submarine, and prior to 1917 all that these instruments showed was the presence of a submarine somewhere in the vicinity.

Much research and experimental work was carried out during the year 1917 under the encouragement and supervision of the Anti-Submarine Division of the Naval Staff. Two hydrophones were invented in the early part of 1917, one by Captain Ryan, R.N., and one by the Board of Invention and Research, which could be used from ships at very slow speed and which gave some indication of the *direction* of the sound; finally, in the summer of 1917, the ability and patience of one inventor, Mr. Nash, were rewarded, and an instrument was devised termed the "fish" hydrophone which to a considerable extent fulfilled the required conditions. Mr. Nash, whose invention had been considered but not adopted by the Board of Invention and Research before he brought it to the Anti-Submarine Division of the Naval Staff, laboured under many difficulties with the greatest energy and perseverance; various modifications in the design were effected until, in October, 1917, the instrument was pronounced satisfactory and supplies were put in hand.

The next step was to fit the "fish" hydrophone in certain auxiliary patrol vessels as well as some destroyers, "P" boats and motor launches, to enter and train men to work it, and finally to organize these vessels into "submarine hunting flotillas," drill them, and then set them to their task.

This work, which occupied some time, was carried out at Portland, where a regular establishment was set up for developing the "fish" hydrophone and for organizing and training the "hunting flotillas" in its use. A considerable amount of training in the use of the hydrophone was required before men became efficient, and only those with a very keen sense of hearing were suited to the work. The chances of the success of the hunting flotillas had been promising in the early experiments, and the fitting out of patrol craft and organizing and drilling them, proceeded as rapidly as the vessels could be obtained, but largely owing to the slow production of trawlers it was not until November that the first hunting flotilla fitted with the "fish" hydrophone was actually at work. The progress made after this date is illustrated by the fact that in December, 1917, a division of drifters, with a "P" boat, fitted with this "fish" hydrophone hunted an enemy submarine for seven hours during darkness, covering a distance of fifty miles, kept touch with her by sound throughout this period, and finished by dropping depth charges in apparently the correct position, since a strong smell of oil fuel resulted and nothing further could be heard of the submarine, although the drifters listened for several hours. On another occasion in the same month a division of drifters hunted a submarine for five hours. The number of hydrophones was increased as rapidly as possible until by the end of the year the system was in full operation within a limited area, and only

required expansion to work, as was intended, on a large scale in the North Sea and the English Channel.

Meanwhile during 1917 *directional* hydrophones, which had been successfully produced both by Captain Ryan and by the Board of Invention and Research, had been fitted to patrol craft in large numbers, and "hunting flotillas" were operating in many areas. A good example of the working of one of these flotillas occurred off Dartmouth in the summer of 1918, when a division of motor launches fitted with the Mark II hydrophone, under the general guidance of a destroyer, carried out a successful attack on a German submarine. Early in the afternoon one of the motor launches dropped a depth charge on an oil patch, and shortly afterwards one of the hydrophones picked up the sound of an internal combustion engine; a line of depth charges was run on the bearing indicated by the hydrophone. The motor launches and the destroyer remained listening, until at about 6.0 P.M. a submarine came to the surface not far from Motor Launch No. 135, which fired two rounds at the submarine before the latter submerged. Other motor launches closed in, and depth charges were dropped by them in close proximity to the wash of the submarine. Oil came to the surface, and more depth charges were dropped in large numbers on the spot for the ensuing forty-eight hours. Eventually objects came to the surface clearly indicating the presence of a submarine. Further charges were dropped, and an obstruction on the bottom was located by means of a sweep. This engagement held peculiar interest for me, since during my visit to Canada in the winter of 1919 the honour fell to me of presenting to a Canadian—Lieutenant G. L. Cassady, R.N.V.R.—at Vancouver the Distinguished Service Cross awarded

him by His Majesty for his work in Motor Launch No. 135 on this occasion.

Motor Launches were organized into submarine hunting flotillas during the year 1917. These vessels were equipped with the directional hydrophone as soon as its utility was established, and were supplied with depth charges. In the summer of 1917 four such hunting flotillas were busy in the Channel; the work of one of these I have described already, and they certainly contributed towards making the Channel an uneasy place for submarine operations.

These results were, of course, greatly improved on in 1918, as the numbers of ships fitted with the "fish" and other hydrophones increased and further experience was gained.

The progress in supply of hydrophones is shown by the following table :

<i>Date.</i> 1917.	<i>Supply of</i> <i>General Service</i> <i>Portable Type.</i>	<i>Directional</i> <i>Mark I and</i> <i>Mark II.</i>	<i>Shark Fin</i> <i>Type.</i>	<i>Fish</i> <i>Type.</i>
July 31 ...	... 2,750	500	—	—
August 31	... 2,750	700	—	—
September 30	... 2,750	850	—	—
October 31	... 3,500	1,000	—	—
December 31	... 3,680	1,950	870	37

Hydrophone Stations and Training Schools

At the beginning of 1917 four *shore hydrophone stations* were in use. During the year eight additional stations were completed and several more were nearing completion. The first step necessary was a considerable increase in the instructional facilities for training listeners both for the increased number of shore stations and

for the large number of vessels that were fitted for hydrophone work during the year.

The greater part of this training took place at the establishment at Hawkeraig, near Rosyth, at which Captain Ryan, R.N., carried out so much exceedingly valuable work during the war. I am not able to give exact figures of the number of officers and men who were instructed in hydrophone work either at Hawkeraig or at other stations by instructors sent from Hawkeraig, but the total was certainly upwards of 1,000 officers and 2,000 men. In addition to this extensive instructional work the development of the whole system of detecting the presence of submarines by sound is very largely due to the work originally carried out at Hawkeraig by Captain Ryan.

The first hydrophone station which was established in the spring of 1915 was from Oxears Lighthouse in the Firth of Forth; it was later in the year transferred to Inchcolm. Experimental work under Captain Ryan continued at Hawkeraig during 1915, and in 1916 a section of the Board of Invention and Research went to Hawkeraig to work in conjunction with him. This station produced the Mark II directional hydrophone of which large numbers were ordered in 1917 for use in patrol craft. It was a great improvement on any hydrophone instrument previously in use. Hawkeraig also produced the directional plates fitted to our submarines, as well as many other inventions used in detecting the presence of submarines.

In addition to the work at Hawkeraig an experimental station under the Board of Invention and Research was established near Harwich in January, 1917. The Mark I directional hydrophone was designed at this establishment in 1917, and other exceedingly valuable

work was carried out there connected with the detection of submarines.

At Malta an experimental station, with a hydrophone training school, was started in the autumn of 1917, and good work was done both there and at a hydrophone station established to the southward of Otranto at about the same time, as well as at a hydrophone training school started at Gallipoli at the end of the year.

"Otters" and Paravanes

The "Otter" system of defence of merchant ships against mines was devised by Lieutenant Dennis Burney, D.S.O., R.N.,* and was on similar lines to his valuable invention for the protection of warships. The latter system had been introduced into the Grand Fleet in 1916, although for a long period considerable opposition existed against its general adoption, partly on account of the difficulties experienced in its early days of development, and partly owing to the extensive outlay involved in fitting all ships. However, this opposition was eventually overcome, and before the end of the war the system had very amply justified itself by saving a large number of warships from destruction by mines. It was computed that there were at least fifty cases during the war in which paravanes fitted to warships had cut the moorings of mines, thus possibly saving the ships. It must also be borne in mind that the cutting of the moorings of a mine and the bringing of it to the surface may disclose the presence of an hitherto unknown minefield, and thus save other ships.

Similarly, the "Otter" defence in its early stages was not introduced without opposition, but again all difficulties were overcome, and the rate of progress in its

* A son of Admiral Sir Cecil Burney.

use is shown in the following statement giving the number of British merchant ships fitted with it at different periods of 1917 :

By July 1, 95 ships had been fitted.

By September 1, 294 ships had been fitted.

By December 1, 900 ships had been fitted.

The system was also extended to foreign merchant ships, and supplies of " Otters " were sent abroad for this purpose.

A considerable number of merchant ships were known to have been saved from destruction by mine by the use of this system.

Defensive Arming of Merchant Ships

The *defensive arming* of merchant ships was a matter which was pressed forward with great energy and rapidity during the year 1917. The matter was taken up with the Cabinet immediately on the formation of the Board of Admiralty presided over by Sir Edward Carson, and arrangements made for obtaining a considerable number of guns from the War Office, from Japan, and from France, besides surrendering some guns from the secondary and anti-torpedo boat armament of our own men-of-war, principally those of the older type, pending the manufacture of large numbers of guns for the purpose. Orders for some 4,200 guns were placed by Captain Dreyer, the Director of Naval Ordnance, with our own gun makers in March, April and May, 1917, in addition to nearly 3,000 guns already on order for this purpose; 400 90-m.m. guns were obtained from France, the mountings being made in England. Special arrangements were also made by Captain Dreyer for

the rapid manufacture of all guns, including the provision of the material and of extra manufacturing plant.

These orders for 4,200 guns and the orders for 2,026 howitzers placed at the same time brought the total number of guns and howitzers under manufacture in England for naval and merchant service purposes in May, 1917, up to the high figure of 10,761.

At the end of the year 1916 the total number of merchant ships that had been armed since the commencement of the war (excluding those which were working under the White Ensign and which had received *offensive* armaments) was 1,420. Of this number, 83 had been lost.

During the first six months of 1917 armaments were provided for an additional 1,581 ships, and during the last six months of that year a further total of 1,406 ships were provided with guns, an aggregate number of 2,987 ships being thus furnished with armaments during the year. This total was exclusive of howitzers.

The progress of the work is shown by the following figures :

<i>Date.</i>	<i>Number of guns that had been provided for British Merchant Ships <u>excluding</u> Howitzers.</i>				
January 1, 1917	1,420
April 1, 1917	2,181
July 1, 1917	8,001
October 1, 1917	8,768
January 1, 1918	4,407

The figures given include the guns mounted in ships that were lost through enemy action or from marine risks.

It should be stated that the large majority of the

guns manufactured during 1917 were 12-pounders or larger guns, as experience had shown that smaller weapons were usually outranged by those carried in submarines, and the projectiles of even the 12-pounder were smaller than was desirable. Of the 2,987 new guns mounted in merchant ships during the year 1917 only 190 were smaller than 12-pounders.

Aircraft for Anti-Submarine Work

Anti-submarine work by aircraft was already in operation round our coasts by the beginning of 1917, and during the year the increase in numbers and improvement in types of machines rendered possible considerable expansion of the work. Closer co-operation between surface vessels and aircraft was also secured, and as the convoy system was extended aircraft were used both for escort and observation work, as well as for attack on submarines. For actual escort work airships were superior to heavier-than-air machines owing to their greater radius of action, whilst for offensive work against a submarine that had been sighted the high speed of the seaplane or aeroplane was of great value.

In 1916 and the early part of 1917 we were but ill provided with aircraft suitable for anti-submarine operations at any considerable distance from the coast, and such aircraft as we possessed did not carry sufficiently powerful bombs to be very effective in attacking submarines, although they were of use in forcing these vessels to submerge and occasionally in bringing our surface craft to the spot to press home the attack.

The Royal Naval Air Service, under Commodore Godfrey Paine, devoted much energy to the provision of suitable aircraft, and the anti-submarine side of the Naval Staff co-operated in the matter of their organiza-

tion; with the advent of the large "America" type of seaplane and the Handley-Page type of aeroplane, both of which carried heavy bombs, successful attacks on enemy submarines became more frequent. They were assisted by the airships, particularly those of the larger type.

Improvements which were effected in signalling arrangements between ships and aircraft were instrumental in adding greatly to their efficiency, and by the early summer of 1917 aircraft had commenced to play an important part in the war against submarines and in the protection of trade.

Thereafter progress became rapid, as the following figures show :

In June, 1917, aeroplanes and seaplanes patrolling for anti-submarine operations covered 75,000 miles, sighted 17 submarines, and were able to attack 7 of them.

In September, 1917, the distance covered by anti-submarine patrols of aeroplanes and seaplanes was 91,000 miles, 25 submarines were sighted, of which 18 were attacked.

In the four weeks ending December 8, 1917, in spite of the much shorter days and the far less favourable flying weather experienced, the mileage covered was again 91,000 miles; 17 submarines were sighted, of which 11 were attacked during this period.

As regards airships the figures again show the increased anti-submarine work carried out :

In June, 1917, airships engaged in anti-submarine patrol covered 53,000 miles, sighted and attacked 1 submarine.

In September, 1917, they covered 88,000 miles, and sighted 8 submarines, of which 5 were attacked.

In the four weeks ending December 8, 1917, they covered 50,000 miles, sighted 6 submarines, and attacked 5 of them.

The airships were more affected by short days, and particularly by bad weather, than the heavier than air craft, and the fact that they covered practically the same mileage in the winter days of December as in the summer days of June shows clearly the development that took place in the interval.

During the whole of 1917 it was estimated that our heavier than air craft sighted 135 submarines and attacked 85 of them, and our lighter than air craft sighted 26 and attacked 15. The figures given in Chapter IX of the number of submarines sunk during the war by aircraft (viz. 7 as a minimum), when compared with the number of attacks during 1917 alone suggest the difficulties of successful attack.

In September, 1917, as extensive a programme as was consistent with manufacturing capabilities, in view of the enormous demands of the Army, was drawn up by the Naval Staff for the development of aircraft for anti-submarine operations during 1918.

The main developments were in machines of the large "America" type and heavy bombing machines for attacking enemy bases, as well as other anti-submarine machines and aircraft for use with the Grand Fleet.

Included in the anti-submarine operations of aircraft during 1917 were the bombing attacks on Bruges, since the German submarines and the shelters in which they took refuge were part of the objective.

These attacks were carried out from the aerodrome established by the Royal Naval Air Service at Dunkirk. During 1917 the Naval Air Forces of the Dover Command, which included the squadrons at Dunkirk, were

under the command of Captain C. L. Lambe, R.N., and the operations of this force were of a very strenuous character and of the utmost value.

Bombing operations prior to the year of 1917 had been carried out by various types of machines, but the introduction of the Handley-Page aeroplanes in the spring of 1917 enabled a much greater weight of bombs—viz. some 1,500 lbs.—to be carried than had hitherto been possible. These machines were generally used for night bombing, and the weight of bombs dropped on the enemy bases in Belgium rose with great rapidity as machines of the Handley-Page type were delivered, as did the number of nights on which attacks were made. It was no uncommon occurrence during the autumn of 1917 for six to eight tons of bombs to be dropped in one night. I have not the figures for 1918, but feel no doubt that with the great increase in aircraft that became possible during that year this performance was constantly exceeded.

Special Service or Decoy Ships

The story of the work of these vessels constitutes a record of gallantry, endurance and discipline which has never been surpassed afloat or ashore. The earliest vessels were fitted out during the year 1915 at Scapa, Rosyth, Queenstown and other ports, and from the very first it was apparent that they would win for themselves a place in history. The earliest success against an enemy submarine by one of these vessels was achieved by the *Prince Charles*, fitted out at Scapa, and commanded by Lieutenant Mark-Wardlaw, an officer on the Staff of Admiral Sir Stanley Colville, then Admiral Commanding the Orkneys and Shetlands. In the early months of 1917 it was decided

to augment greatly the force of these special service vessels, and steps were taken to organize a separate Admiralty Department for the work. Special experience was needed, both for the selection of suitable ships and for fitting them out, and care was taken to select officers who had been personally connected with the work during the war; the advice of successful commanders of decoy ships was also utilized. At the head was Captain Alexander Farrington, under whose directions several ships had been fitted out at Scapa with great ingenuity and success. Every class of ship was brought into the service: steam cargo vessels, trawlers, drifters, sailing ships, ketches, and sloops specially designed to have the appearance of cargo ships. These latter vessels were known as "convoy sloops" to distinguish them from the ordinary sloop. Their design, which was very clever, had been prepared in 1916 by Sir Eustace T. D'Eyncourt, the Director of Naval Construction. The enemy submarine commanders, however, became so wary owing to the successes of decoy ships that they would not come to the surface until they had inspected ships very closely in the submerged condition, and the fine lines of the convoy sloops gave them away under close inspection.

In the early spring of 1917 the Director of Naval Construction was asked whether the "P" class of patrol boats then under construction could be altered to work as decoy vessels, as owing to their light draught they would be almost immune from torpedo attack.

A very good design was produced, and some of the later patrol boats were converted and called "P Q's." These vessels had the appearance of small merchant ships at a cursory glance. They would not, however, stand close examination owing, again, to their fine lines, but being better sea boats than the "P's," by reason of

their greater freeboard, the design was continued, and they met with considerable success against submarines (especially in the Irish Sea) by ramming and depth charge tactics, the submarines when submerged probably not realizing when observing the "P Q.'s" through a periscope the speed of which they were capable.

During 1917, when the unrestricted submarine warfare was in progress, many of the decoy vessels were fitted with torpedo tubes, either above water or submerged, since, as the submarine commanders became more wary, they showed great dislike to coming to the surface sufficiently close to merchant ships to admit of the gun armament being used with certainty of success. A torpedo, on the other hand, could, of course, be used effectively against a submarine whilst still submerged. The use also became general of casks or cargoes of wood to give additional flotation to decoy ships after being torpedoed, so as to prolong their life in case the submarine should close near enough to allow of effective gunfire.

Another ruse adopted was that of changing the disguise of a decoy ship during the night, so that she could not be identified by a submarine which had previously made an attack upon her. In all cases of disguise or of changing disguise it was essential that the decoy ship should assume the identity of some class of vessel likely to be met with in the particular area in which she was working, and obviously the courses steered were chosen with that object in view.

Again, since for success it was essential to induce the submarine to come within close range so that the decoy ship's gunfire should be immediately effective, it was necessary that her disguise should stand the closest possible examination through the periscope of a submarine. German submarine commanders, after a short experience of

decoy ships, were most careful not to bring their vessels to the surface in proximity to craft that were apparently merchant ships until they had subjected them to the sharpest scrutiny at short range through the periscope, and the usual practice of an experienced submarine commander was to steer round the ship, keeping submerged all the time.

Not only was it essential that there should be no sign of an armament in the decoy ship, or a man-of-war-like appearance in any respect, but when the "panic" signal was made to lead the submarine commander to think that his attack had succeeded, precautions had to be taken against the presence of more than the ordinary number of men in the boats lowered and sent away with the supposed whole ship's company; also the sight of any men left on board would at once betray the real character of the decoy ship and result in the disappearance of the submarine and the probable sinking of the disguised craft by torpedo fire.

During the late summer of 1917 it became evident that the submarine commanders had become so suspicious of decoy craft that the chances of success by the larger cargo vessels were not sufficient to justify any further addition to existing numbers in view of the increasing shortage of shipping; a considerable fleet of steamers building for this purpose was therefore diverted to trade purposes. The number of smaller vessels, particularly sailing craft, was, however, increased especially in Mediterranean waters where they had not been previously operating on an extensive scale.

It is impossible to close these remarks on this class of vessel without testifying once more to the splendid gallantry, self-sacrifice, skilful resource and magnificent discipline shown by those on board. This is illustrated by descriptions of a few typical actions fought during 1917.

The first which I relate took place on February 17, 1917, when a decoy vessel, a steamship armed with five 12-pounder guns, commanded by that most gallant officer, Captain Gordon Campbell, R.N., was torpedoed by a submarine in a position Lat. 51.34 N., Long. 11.23 W.

Captain Campbell saw the torpedo coming and manœuvred to try and avoid being hit in the engine-room, but as he purposely always selected a very slow ship for decoy work his attempt was only partially successful and the engine-room began to fill. No signal for assistance was made, however, as Captain Campbell feared that such a signal might bring another vessel on the scene and this would naturally scare the submarine away. The usual procedure of abandoning the ship in the boats with every appearance of haste was carried out, only sufficient hands remaining hidden on board to work the guns. The periscope of the submarine was next sighted on the quarter within 200 or 300 yards, and she came slowly past the ship still submerged and evidently examining the vessel closely through the periscope. She passed within a few yards of the ship, then crossed the bow and came to the surface about 200 yards off and passed down the port side again close to. Captain Campbell waited until every gun would bear before giving the signal for "action." The decoy ship's true character was then revealed; concealed gunports were thrown open; colours were hoisted, and a hot fire opened from all guns. The submarine was hit at once and continued to be hit so rapidly that it was evidently impossible for her to submerge. She sank in a very short time. One officer and one man were picked up. A signal was then made for assistance and help arrived within a couple of hours. The decoy ship was rapidly filling, but efforts were made to tow her into port, and with the greatest difficulty, and

entirely owing to the splendid manner in which all hands stuck to the work, she was brought into Berehaven with her stern under water thirty-six hours later and beached. The great restraint shown by Captain Campbell, in withholding fire as the submarine passed her in a submerged condition, and the truly wonderful discipline and steadiness and ingenuity which baffled so close an examination of the ship were the outstanding features of this great exploit.

On April 22, 1917, a decoy ship known as "Q 22," a small sailing vessel with auxiliary power, armed with two 12-pounder guns, and commanded by Lieutenant Irvine, R.N.R., while in a position about fifty miles south of Kinsale Head, sighted a submarine on the surface which opened fire immediately at a range of about 4,000 yards. The fire was accurate and the decoy ship was hit frequently, two men being killed and four wounded in a few minutes and the vessel considerably damaged. As further concealment appeared useless the guns were then unmasked and the fire returned with apparently good results, several hits being claimed. The enemy's fire then fell off in accuracy and she increased the range, and after about one and a half hours' fighting the light became too bad to continue the action. It was thought that the submarine was sunk, but there was no positive evidence of sinking.

On April 30, 1917, a decoy ship—H.M.S. *Prize*—a small schooner with auxiliary power, armed with two 12-pounder guns and commanded by Lieutenant W. E. Sanders, R.N.R., a New Zealand officer, sighted, when in position Lat. 49.44 N., Long. 11.42 W., a submarine about two miles away on the port beam at 8.30 P.M. At 8.45 P.M. the submarine opened fire on the *Prize* and the "abandon ship" party left in a small boat. The submarine gradually approached, continuing

to pour in a heavy fire and making two hits on the *Prize* which put the motor out of action, wrecked the wireless office, and caused much internal damage besides letting a great deal of water into the ship.

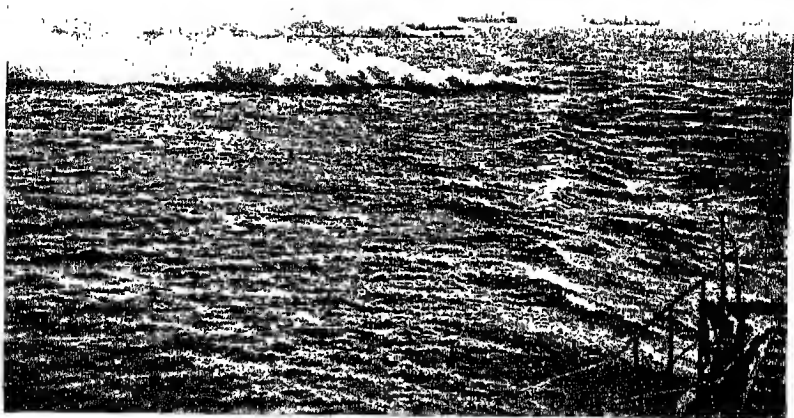
The crew of the *Prize* remained quietly hidden at their concealed guns throughout this punishment, which continued for forty minutes as the submarine closed, coming up from right astern, a position no doubt which she considered one of safety. When close to she sheered off and passed to the port beam at a distance of about one hundred yards. At this moment Lieutenant Sanders gave the order for "action." The guns were exposed and a devastating fire opened at point blank range, but not before the submarine had fired both her guns, obtaining two more hits, and wounding several of the crew of the *Prize*. The first shell fired from the *Prize* hit the foremost gun of the submarine and blew it overboard, and a later shot knocked away the conning tower. The submarine went ahead and the *Prize* tried to follow, but the damage to her motor prevented much movement. The firing continued as the submarine moved away, and after an interval she appeared to be on fire and to sink. This occurred shortly after 9.0 P.M., when it was nearly dark. The *Prize* sent her boats to pick up survivors, three being taken out of the water, including the commander and one other officer. The prisoners on coming on board expressed their willingness to assist in taking the *Prize* into port. It did not at this time seem likely that she would long remain afloat, but by great exertion and good seamanship the leaks were got under to a sufficient extent to allow of the ship being kept afloat by pumping. The prisoners gave considerable help, especially when the ship caught fire whilst starting the motor again. On May 2 she met a motor launch off the coast of Ireland and was

towed into port. In spite of the undoubted great damage to the submarine, damage confirmed by the survivors, who were apparently blown overboard with the conning tower, and who had no thought other than that she had been sunk, later intelligence showed that she succeeded in reaching Germany in a very disabled condition. This incident accentuated still further the recurrent difficulty of making definite statements as to the fate of enemy submarines, for the evidence in this case seemed absolutely conclusive. The commander of the submarine was so impressed with the conduct of the crew of the *Prize* that when examined subsequently in London he stated that he did not consider it any disgrace to have been beaten by her, as he could not have believed it possible for any ship's company belonging to any nation in the world to have been imbued with such discipline as to stand the shelling to which he subjected the *Prize* without any sign being made which would give away her true character.

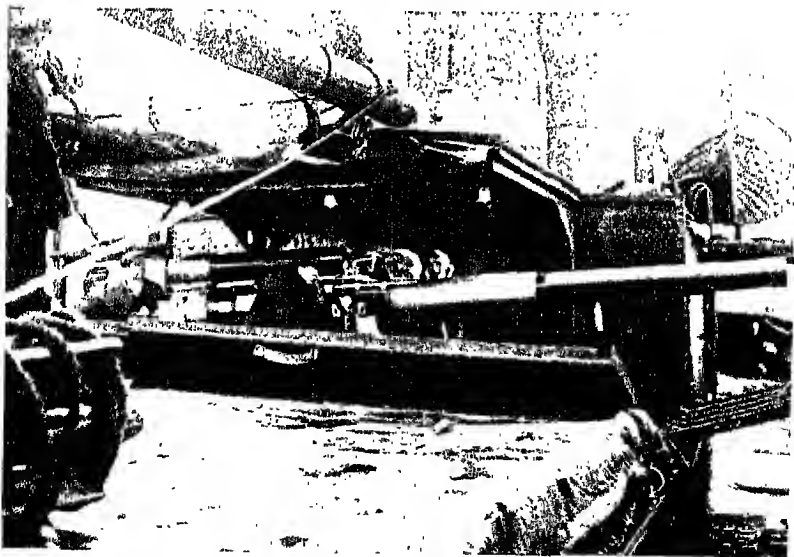
Lieut.-Commander Sanders was awarded the Victoria Cross for his action and many decorations were given to the officers and ship's company for their conduct in the action. It was sad that so fine a commander and so splendid a ship's company should have been lost a little later in action with another submarine which she engaged unsuccessfully during daylight, and which followed her in a submerged condition until nightfall and then torpedoed her, all hands being lost.

It was my privilege during my visit to New Zealand in 1919 to unveil a memorial to the gallant Sanders which was placed in his old school at Takapuna, near Auckland.

On June 7, 1917, a decoy ship, the s.s. *Pargust*, armed with one 4-inch gun, four 12-pounder guns and two torpedo tubes, commanded by Captain Gordon



A Smoke Screen for a Convoy.



The Dummy Deck-house of a Decoy Ship.

Campbell, R.N., who had meanwhile been awarded the Victoria Cross, was in a position Lat. 51.50 N., Long. 11.50 W., when a torpedo hit the ship abreast the engine-room and in detonating made a hole through which water poured, filling both engine-room and boiler-room. The explosion of the torpedo also blew one of the boats to pieces. The usual procedure of abandoning ship was carried out, and shortly after the boats had left, the periscope of a submarine was sighted steering for the port side. The submarine passed close under the stern, steered to the starboard side, then recrossed the stern to the port side, and when she was some fifty yards off on the port beam her conning tower appeared on the surface and she steered to pass round the stern again and towards one of the ship's boats on the starboard beam. She then came completely to the surface within one hundred yards, and Captain Campbell disclosed his true character, opened fire with all guns, hitting the submarine at once and continuing to hit her until she sank. One officer and one man were saved. The decoy ship lost one man killed, and one officer was wounded by the explosion of the torpedo.

As in the case of the action on February 17 the distinguishing feature of this exploit was the great restraint shown by Captain Campbell in withholding his fire although his ship was so seriously damaged. The gallantry and fine discipline of the ship's company, their good shooting and splendid drill, contributed largely to the success. The decoy ship, although seriously damaged, reached harbour.

On July 10, 1917, a decoy ship, H.M.S. *Glen*, a small schooner with auxiliary power and armed with one 12-pounder and one 6-pounder gun, commanded by Sub-Lieutenant K. Morris, R.N.R., was in a position about forty miles south-west of Weymouth when a submarine

was sighted on the surface some three miles away. She closed to within two miles and opened fire on the *Glen*. The usual practice of abandoning ship was followed, the submarine closing during this operation to within half a mile and remaining at that distance examining the *Glen* for some time. After about half an hour she went ahead and submerged, and then passed round the ship at about 200 yards distance, examining her through the periscope, finally coming to the surface about 50 yards off on the port quarter. Almost immediately she again started to submerge, and fire was at once opened. The submarine was hit three or four times before she turned over on her side and disappeared. There was every reason to believe that she had sunk, although no one was on deck when she disappeared. No survivors were rescued.

The feature of this action was again the restraint shown by the commanding officer of the *Glen* and the excellent discipline of the crew.

On August 8, 1917, the decoy ship H.M.S. *Dunraven*, in Lat. 48.0 N., Long. 7.37 W., armed with one 4-inch and four 12-pounder guns and two torpedo tubes, commanded by Captain Gordon Campbell, V.C., R.N., sighted a submarine on the surface some distance off. The submarine steered towards the ship and submerged, and soon afterwards came to the surface some two miles off and opened fire. The *Dunraven*, in her character of a merchant ship, replied with an after gun, firing intentionally short, made a smoke screen, and reduced speed slightly to allow the submarine to close.

When the shells from the submarine began to fall close to the ship the order to abandon her was given, and, as usual with the splendidly trained ship's company working under Captain Campbell, the operation was carried out with every appearance of order, one

of the boats being purposely left hanging vertical with only one end lowered. Meanwhile the submarine closed. Several shells from her gun hit the after part of the *Dunraven*, causing a depth charge to explode and setting her on fire aft, blowing the officer in charge of the after gun out of his control station, and wounding severely the seaman stationed at the depth charges. The situation now was that the submarine was passing from the port to the starboard quarter, and at any moment the 4-inch magazine and the remaining depth charges in the after part of the *Dunraven* might be expected to explode. The 4-inch gun's crew aft knew the imminence of this danger, but not a man moved although the deck beneath them was rapidly becoming red hot; and Captain Campbell was so certain of the magnificent discipline and gallantry of his crew that he still held on so that the submarine might come clearly into view on the starboard side clear of the smoke of the fire aft. In a few minutes the anticipated explosion occurred. The 4-inch gun and gun's crew were blown into the air just too soon for the submarine to be in the best position for being engaged. The explosion itself caused the electrical apparatus to make the "open fire" signal, whereupon the White Ensign was hoisted and the only gun bearing commenced firing; but the submarine submerged at once.

Fifteen minutes later a torpedo hit the ship, and Captain Campbell again ordered "abandon ship" and sent away a second party of men to give the impression that the ship had now been finally abandoned although her true character had been revealed. Meanwhile he had made a wireless signal to other ships to keep away as he still hoped to get the submarine, which, now keeping submerged, moved round the ship for three quarters of an hour, during which period the fire gained on the

Dunraven and frequent explosions of ammunition took place.

The submarine then came to the surface right astern where no guns could bear on her, and recommenced her shellfire on the ship, hitting her frequently. During this period the officers and men still remaining on board gave no sign of their presence, Captain Campbell, by his example, imbuing this remnant of his splendid ship's company with his own indomitable spirit of endurance. The submarine submerged again soon afterwards, and as she passed the ship Captain Campbell from his submerged tube fired a torpedo at her, which just missed. Probably the range was too short to allow the torpedo to gain its correct depth. She went right round the ship, and a second torpedo was fired from the other tube, which again missed. This torpedo was evidently seen from the submarine, as she submerged at once. The ship was sinking, and it was obviously of no use to continue the deception, which could only lead to a useless sacrifice of life; wireless signals for assistance were therefore made, and the arrival of some destroyers brought the action to a conclusion. The wounded were transferred to the destroyers and the ship taken in tow, but she sank whilst in tow forty-eight hours later.

This action was perhaps the finest feat amongst the very many gallant deeds performed by decoy ships during the war. It displayed to the full the qualities of grim determination, gallantry, patience and resource, the splendid training and high standard of discipline, which were necessary to success in this form of warfare. Lieutenant Charles G. Bonner, R.N.R., and Petty-Officer Ernest Pitcher, R.N., were awarded the V.C. for their services in this action, and many medals for conspicuous gallantry were also given to the splendid ship's company.

Captain Campbell, as will be readily realized, met with great success in his work, and he was the first to acknowledge how this success was due to those who worked so magnificently under his command, and he also realized the magnitude of the work performed by other decoy ships in all areas, since he knew better than most people the difficulties of enticing a submarine to her doom.

On September 17, 1917, in position Lat. 49.42 N., Long. 18.18 W., the decoy ship *Stonecrop*, a small steamer commanded by Commander M. Blackwood, R.N., armed with one 4-inch, one 6-pounder gun and some stick-bomb throwers and carrying four torpedo tubes, sighted a submarine, which opened fire on her at long range, the fire being returned by the 6-pounder mounted aft. After the shelling had continued for some time the usual order was given to "abandon ship," and a little later the periscope of the submarine was sighted some distance away. The submarine gradually closed, keeping submerged, until within about a quarter of a mile, when she passed slowly round the ship, and finally came to the surface at a distance of about 500 yards on the starboard quarter. She did not close nearer, so the order was given to open fire, and hitting started after the third round had been fired and continued until the submarine sank stern first. No survivors were picked up, but all the indications pointed to the certainty of the destruction of the submarine.

Patrol Gunboats

Mention may here be made of another vessel of a special class designed in 1917. In the early summer, in consequence of the shortage of destroyers, of the delays in the production of new ones, and the great need for more

small craft suitable for escorting merchant ships through the submarine zone, arrangements were made to build a larger and faster class of trawler which would be suitable for convoy work under favourable conditions, and which to a certain extent would take the place of destroyers. Trawlers could be built with much greater rapidity than destroyers, and trawler builders who could not build destroyers could be employed for the work, thus supplementing the activities of the yards which could turn out the bigger craft.

Accordingly a 18-knot trawler was designed, and a large number ordered. Great delays occurred, however, in their construction, as in that of all other classes of vessel owing to the pressure of various kinds of war work and other causes, and only one was delivered during 1917 instead of the twenty or so which had been promised, whilst I believe that by July, 1918, not more than fourteen had been completed instead of the anticipated number of forty. I was informed that they proved to be a most useful type of vessel for the slower convoys, were excellent sea boats, with a large radius of action, were a great relief to the destroyers, and even to light cruisers, for convoy work. It is understood that some fifty were completed by the end of the war.

Net Protection for Merchant Ships

This idea originated in 1915 or 1916 with Captain Edward C. Villiers, of the *Actæon* Torpedo School ship. Experiments were carried out by a battleship at Rosyth, in the first instance, and later at Scapa. They were at that time unsuccessful.

At the end of 1916 I gave directions for a reconsideration of the matter, and fresh trials were made; but early in 1917 there seemed to be no prospect of

success, and the trials were again abandoned. However, Captain Villiers displayed great confidence in the idea, and he introduced modifications, with the result that later in the year 1917 directions were given for fresh trials to be undertaken. At the end of the year success was first obtained, and this was confirmed early in 1918, and the device finally adopted. A curious experience during the trials was that the vessel carrying them out was actually fired at by a German submarine, with the result that the net protection saved the ship from being torpedoed. It is not often that an inventor receives such a good advertisement.

Depth Charge Throwers

The first proposal for this device came from Portsmouth, where the Commander-in-Chief, Admiral the Hon. Sir Stanley Colville, was indefatigable in his efforts to combat the submarine; throwers manufactured by Messrs. Thornycroft, of Southampton, were tried and gave good results. The arrangement was one by which depth charges could be projected to a distance of 40 yards from a vessel, and the throwers were usually fitted one on each quarter so that the charges could be thrown out on the quarter whilst others were being dropped over the stern, and the chances of damaging or sinking the submarine attacked were thus greatly increased.

As soon as the earliest machines had been tried orders were placed for large numbers and the supplies obtained were as follows :

Deliveries commenced in July, 1917.

By September 1, 80 had been delivered.

By October 1, 97 had been delivered.

By December 1, 288 had been delivered.

Coastal Motor Boats

At the end of 1916 we possessed 13 fast coastal motor boats, carrying torpedoes, and having a speed of some 36 knots. They had been built to carry out certain operations in the Heligoland Bight, working from Harwich, but the preliminary air reconnaissance which it had been decided was necessary had not been effected by the end of 1916 owing to bad weather and the lack of suitable machines.

When winter set in it became impossible, with the type of aircraft then existing, to carry out the intended reconnaissance, and early in 1917 I abandoned the idea of the operations for the winter and sent the boats to the Dover Command for Sir R. Bacon to use from Dunkirk in operations against enemy vessels operating from Ostend and Zeebrugge. They quickly proved their value, and it became evident that they would also be useful for anti-submarine work. A large number were ordered, some for anti-submarine work and some for certain contemplated operations in enemy waters, including a night attack on the enemy's light cruisers known to lie occasionally in the Ems River, an operation that it was intended to carry out in the spring of 1918. A daylight operation in this neighbourhood, which was carried out during 1918, did not, from the published reports, meet with success, the coastal motor boats being attacked by aircraft, vessels against which they were defenceless. The new boats were of an improved and larger type than the original 40-foot boats. Delays occurred in construction owing principally to the difficulty in obtaining engines by reason of the great demand for engines for aircraft, and but few of the new boats were delivered during the year 1917.

Mining Operations

The policy which was carried out during 1917 in this respect, so far as the supply of mines admitted, aimed at preventing the exit of submarines from enemy ports. Incidentally, the fact that we laid large numbers of mines in the Heligoland Bight rendered necessary such extensive sweeping operations before any portion of the High Sea Fleet could put to sea as to be very useful in giving us some indication of any movement that might be intended. In view of the distance of the Grand Fleet from German bases and the short time available in which to intercept the High Sea Fleet if it came out for such a purpose as a raid on our coasts, or on convoys, the information thus gathered would have proved of great value.

In planning mining operations in the Heligoland Bight, it was necessary to take into consideration certain facts. The *first* was the knowledge that the Germans themselves had laid minefields in some portions of the Bight, and it was necessary for our minelayers to give such suspected areas a wide berth. *Secondly*, it was obvious that we could not lay minefields in areas very near those which we ourselves had already mined, since we should run the risk of blowing up our own ships with our own mines.

Mining operations had necessarily to be carried out at night, and as there were no navigational aids in the way of lights, etc., in the Heligoland Bight, the position in which our mines were laid was never known with *absolute* accuracy. Consequently an area in which we had directed mines to be laid, and to which a minelayer had been sent, could not safely be approached within a distance of some five miles on a subsequent occasion.

The use in mining operations of the device known as "taut wire" gear, introduced by Vice-Admiral Sir Henry Oliver, was of great help in ensuring accuracy in laying mincfields and consequently in reducing the danger distance surrounding our own mincfields.

As our mining operations increased in number we were driven farther and farther out from the German ports for subsequent operations. This naturally increased the area to be mined as the Heligoland Bight is bell-mouthed in shape, but it had the advantage of making the operations of German minesweepers and mine-bumpers more difficult and hazardous as they had to work farther out, thus giving our light forces better chances of catching them at work and engaging them. Such actions as that on November 17, 1917, between our light forces and the German light cruisers and minesweepers were the result. We did not, of course, lay mines in either the Danish or Dutch territorial waters, and these waters consequently afforded an exit for German vessels as our minefields became most distant from German bases.

Broadly speaking, the policy was to lay mines so thoroughly in the Heligoland Bight as to force enemy submarines and other vessels to make their exits along the Danish or Dutch coasts in territorial waters.

At the end of the exit we stationed submarines to signal enemy movements and to attack enemy vessels. We knew, of course, that the enemy would sweep other channels for his ships, but as soon as we discovered the position of these channels, which was not a very difficult matter, more mines were laid at the end. In order to give neutrals fair warning, certain areas which included

the Heligoland Bight were proclaimed dangerous. In this respect German and British methods may be contrasted: We never laid a minefield which could possibly have been dangerous to neutrals without issuing a warning stating that a certain area (which included the minefield) was dangerous. The Germans never issued such a warning unless the proclamation stating that half the Atlantic Ocean, most of the North Sea, and nine-tenths of the Mediterranean were dangerous could be considered as such. It was also intended, as mines became available, to lay more deep minefields in positions near our own coast in which enemy submarines were known to work; these minefields would be safe for the passage of surface vessels, but our patrol craft would force the submarines to dive into them. This system to a certain extent had already been in use during 1915 and 1916.

Schemes were also being devised by Admiral of the Fleet Sir Arthur Wilson, who devoted much of his time to mining devices, by which mines some distance below the surface would be exploded by an enemy submarine even if navigating on the surface.

Such was the policy. Its execution was difficult.

The first difficulty lay in the fact that we did not possess a thoroughly satisfactory mine. A percentage only of our mines exploded when hit by a submarine, and they failed sometimes to take up their intended depth when laid, betraying their presence by appearing on the surface.

Energetic measures were adopted to overcome this latter defect, but it took time and but few mines were available for laying in the early months of 1917.

The result of our minelaying efforts is shown in the following table:

Year.				<i>Mines laid in the Heligoland Bight.</i>	<i>Deep mines laid off our own coasts to catch submarines.</i>
1915	...	...	...	4,498	988
1916	...	...	...	1,679	2,578
First quarter of 1917	...		...	4,865	} 3,848
Second	„	„	...	6,886	
Third	„	„	...	8,510	

In the Straits of Dover, Thames Estuary and off the Belgian coast we laid 2,664 mines in 1914, 6,337 in 1915, 9,685 in 1916, and 4,669 in the first three quarters of 1917.

These last mines were laid as fast as the alterations, made with a view to increasing their efficiency, could be carried out.

During the early part of the year 1917 the new pattern of mine, known as the "H" Type, evolved in 1916, had been tried, and although not perfectly satisfactory at the first trials, the success was sufficient to warrant the placing of orders for 100,000 mines and in making arrangements for the quickest possible manufacture. This was done by the Director of Torpedoes and Mines, Rear-Admiral the Hon. Edward Fitzherbert, under the direction of the then Fourth Sea Lord, Rear-Admiral Lionel Halsey.

Deliveries commenced in the summer of 1917, but by the end of September only a little over 1,500 were ready for laying. Some 500 of these were laid in September in the Heligoland Bight and were immediately successful against enemy submarines. More were laid in the Bight during October, November and December, and the remainder, as they were produced, were prepared for laying in the new minefield in the Straits of Dover. *In the fourth quarter of the year a total of 10,389 mines was laid in the Heligoland Bight and in the Straits of Dover.*

During this last quarter delivery of "H" pattern

mines was as follows : In October 2,350, November 5,800, December 4,800 ; total 12,450. So that it will be seen that the mines were laid as fast as delivery was made.

The great increase in projected minelaying operations during the year 1917 made it necessary also to add considerably to the number of minelaying vessels.

In January, 1917, the only vessels equipped for this service were four merchant ships and the Flotilla Leader *Abdiel*, with a total minelaying capacity of some 1,200 mines per trip. It was not advisable to carry out minelaying operations in enemy waters during the period near full moon owing to the laibility of the minelayers being seen by patrol craft. Under such conditions the position of the minefield would be known to the enemy. As the operation of placing the mines on board occupied several days, it was not possible to depend on an average of more than three operations per ship per month from the larger minelayers. Consequently, with the intended policy in view, it was obvious that more minelayers must be provided.

It was inadvisable to use merchant ships, since every vessel was urgently required for trade or transport purposes, and the alternative was to fit men-of-war for minelaying. The only old vessels of this type suitable for mining in enemy waters were ships of the "Ariadne" class, and although their machinery was not too reliable, two of these vessels that were seaworthy were converted to minelayers. In addition a number of the older light cruisers were fitted with portable rails on which mines could be carried when minelaying operations were contemplated, in place of a portion of the armament which could be removed ; a flotilla of destroyers, with some further flotilla leaders, were also fitted out as minelayers, and several additional submarines were fitted for this purpose.

For a projected special scheme of minelaying in enemy waters a number of lighters were ordered, and some of the motor launches and coastal motor boats were fitted out and utilized for mining operations on the Belgian coast towards the end of 1917.

By the end of that year 12 light cruisers, 12 destroyers and flotilla leaders and 5 submarines had been fitted for minelaying. Two old cruisers had been added to the minelaying fleet and several other vessels were in hand for the same purpose. The detailed plans of the arrangements were prepared and the work of fitting out minelayers carried out under the supervision of Admiral R. N. Ommanney, C.B., whose services in this matter were of great value. The rapidity with which ships were added to the minelaying fleet was largely due to his efforts.

On the entry of the United States of America into the war a further development of mining policy became feasible. The immense manufacturing resources of the United States rendered a large production of mines an easy matter, with the result that as soon as the United States Navy produced a reliable type of mine the idea of placing a mine barrage across the northern part of the North Sea which had been previously discussed became a matter of practical politics. With this end in view a still further addition to the minelaying fleet became necessary, and since the mining would be carried out at leisure in this case and speed was no great necessity for the minelayer owing to the distance of the minefields from enemy waters, an old battleship was put in hand for conversion.

With the enormous increase in the number of mines on order the problem of storage became of importance, including as it did the storage of the very large number, some 120,000, required for the northern barrage.

The Third Sea Lord, Admiral Lionel Halsey, took this matter in hand with characteristic energy, and in conjunction with United States naval officers made all the necessary arrangements.

The United States mines were stored in the vicinity of Invergordon, and the British mines intended for use in the northern barrage were located at Grangemouth, near Leith, where Rear-Admiral Clinton Baker was in charge, as well as in other places, whilst those for use in the Heligoland Bight and Channel waters were stored at Immingham and other southern depots.

The laying of the North Sea mine barrage was not accomplished without very considerable delay, and many difficulties were encountered. It was originally anticipated that the barrage would be completed in the spring of 1918, but owing to various defects in both British and United States mines which made themselves apparent when the operations commenced, due partly to the great depth of water as well as to other causes, a delay of several months took place; and, even when near completion, the barrage was not so effective as many had hoped in spite of the great expenditure of labour and material involved. I have not the figures of the number of submarines that the barrage is thought to have accounted for, but it was known to be disappointing.

Flares

In the late summer of 1917 *flares* were experimented with; they were intended to be used from kite balloons with the object of sighting submarines when on the surface at night. Previously searchlights in destroyers had been used for this purpose. The flares were not much used, however, from kite balloons owing to lack of opportunity, but trials which were carried out with flares from patrol

craft, such as trawlers and drifters, demonstrated that they would be of value from these vessels, and when the Folkestone-Grisnez minefield was laid in November and December, 1917, it was apparent that the flares would be of use in forcing submarines to dive at night into the minefield to escape detection on the surface and attack by gunfire.

Manufacture on a large scale was therefore commenced, and during 1918 the flares were in constant use across the Straits of Dover.

Electrical Submarine Detector

The existence of this very valuable device was due to the work of certain distinguished scientists, and experiments were carried out during 1917. It was brought to perfection in the late autumn, and orders were given to fit it in certain localities. Some difficulty was experienced in obtaining the necessary material, but the work was well in hand by the end of the year, and quickly proved its value.

Submarine Against Submarine

Prior to the year 1917 the only areas in which our own submarines operated against enemy vessels of the same type was in the North Sea, or occasionally in the vicinity of the Hebrides. Grand Fleet submarines were used in the northern areas during 1916, and Harwich submarines operated farther south, but the number of underwater craft available was insufficient for any extended method of attack. Early in 1917, when our mercantile losses were very heavy, some submarines were withdrawn from the Harwich and Humber districts and formed into a flotilla off the coast of Ireland for this form of operation. Some risk had to be accepted in thus re-

ducing our submarine strength in southern waters. At the same time some Grand Fleet submarines were organized into a watching patrol in the area off the Shetland Islands, through which enemy submarines were expected to pass. The watch off the Horn Reef and in the Heligoland Bight, which had previously been in force, was also maintained.

A little later the submarine flotilla off the Irish coast was strengthened, and a regular patrol instituted near the North Channel between Ireland and Scotland. The next step was the withdrawal of some "C" Class submarines from coastal work on our east coast to work in the area between England and Holland near the North Hinder Lightship, a locality much frequented by enemy submarines on passage. Still later some submarines were attached to the Portsmouth Command, where, working under Sir Stanley Colville, they had some striking successes; others went to the Dover Command. The latter were fitted with occulting lights on top of the conning-tower, and were moored at night to buoys in the Dover Net Barrage, in places where enemy submarines were likely to pass, in order that they might have a chance of torpedoing them. A division of submarines was also sent to Gibraltar, to operate against enemy cruiser submarines working in that vicinity or near the Canaries. Successes against enemy submarines were also obtained in the latter locality.

Finally, the arrival of some United States submarines enabled the areas in which this form of attack was in force to be still further extended, after the American personnel had been trained to this form of warfare. There was a great increase in the number of enemy submarines sunk by this method of attack during 1917 as compared with previous years; the number of vessels sunk does

not, however, convey a complete appreciation of the effect of this form of anti-submarine warfare. The great value of it lay in the feeling of insecurity that it bred in the minds of the enemy submarine commanders. The moral effect of the constant apprehension that one is being "stalked" is considerable. Indeed, the combination of our aircraft and our submarine patrols led to our vessels reporting, regretfully, that it was very seldom that German submarines were found on the surface in daylight, and towards the end of 1917 quite a large proportion of the attacks on merchant ships took place at night.

The work for our own vessels was very arduous indeed. It was only on rare occasions that it was possible to bring off a successful attack on a submarine that had been sighted, the low underwater speed of submarines making it difficult to get into position when the enemy was only sighted at short range, which was naturally usually the case.

In order to obviate this difficulty directions were given in 1917 to design a special type of submarine for this form of warfare, and I believe that the first vessel was completed by the autumn of 1918.

This account of the development of anti-submarine measures during 1917 would not be complete without mention of the work of the Trade Division of the Staff, of which Captain Richard Webb, C.B., was the Director until September.

This Division was either partly or wholly responsible for :

- (1) The great increase in the rapidity of placing the armaments on board merchant ships.

- (2) The establishment of schools of instruction for captains and officers of the Mercantile Marine.

This training scheme was begun at Chatham Barracks in February, 1917, by Commander F. L. B. Lockyer, acting under Captain Webb, and later was extended to Portsmouth, Cardiff and Greenock. Its success was so marked, and its benefit in assisting officers to handle their ships in the manner best calculated to save them from submarine attack so great, that the Admiralty was continually being pressed by shipowners and by the officers of the Mercantile Marine to extend the instruction to more and more ports. This was done so far as possible, our principal difficulty being to provide officers capable of giving the instruction required.

(3) The provision of wireless plant and operators to the Mercantile Marine. This was another matter taken up with energy during 1917, and with excellent results.

(4) The drilling of guns crews for the merchant ships. Men were invited to go through a course of drill, and large numbers responded and were instructed at the Royal Naval Depot at the Crystal Palace.

All these matters were additional to the important work upon which the Trade Division was constantly employed, which included all blockade questions, the routing of merchant ships, examination of ships, etc.

In addition to the instructional anti-submarine course for masters and officers, gunnery courses for cadets and apprentices were started at Portsmouth, Chatham and Devonport. A system of visits to ships by officer instructors for the purpose of affording instruction and for inspection, as well as for the purpose of lecturing, was instituted, and arrangements were made for giving in-

struction in signalling. Some idea of the work carried out will be gathered from the following figures showing the instructional work carried out during the year 1917 :

Masters	...	...	...	...	1,929
Officers	...	...	...	...	2,149
Number of cadets and apprentices passed through the gunnery course					513
Number of merchant seamen trained in gunnery at the Crystal Palace ...					3,961
Number of ships visited by officer instructors	...	...	...		6,927
Numbers attending these lectures :					
Masters	...	...	...	...	1,361
Officers	...	...	...	...	5,921
Number of officers and men instructed in signalling	...	...	...		10,487

The keenness shown by officers and men of the merchant service contributed in a marked degree to the success of the courses instituted ; just one example may be given. I visited the Royal Naval Depot at the Crystal Palace early in 1918, and amongst other most interesting scenes witnessed a large number of men of the merchant service at gun drill. I questioned several of them as to their experiences, and many of the men had had their ships torpedoed under them three, four or five times. Amongst the gun crews was a steward who had been through this experience four times. On my asking why he, as a steward, should be going through the gunnery course, he replied that he hoped that by so doing he might stand a chance of getting his own back by assisting to sink a submarine.

The knowledge which I possessed of the measures in-

troduced during the year 1917 to combat the German submarine warfare, and the continual increase in the efficiency of the anti-submarine work which I knew would result from increased production of anti-submarine vessels and weapons, led me in February, 1918, to state that in my opinion the submarine menace would be "held" by the autumn of the year 1918. The remark, which was made at what I understood to be a private gathering, was given very wide publicity, and was criticized at the time, but it was fulfilled, as the figures will indicate.

As a matter of interest relative to this chapter, a small chart (C) is included in the pocket at the end; it shows the barred zone declared by the Germans as the area in which all ships would be sunk without warning.

CHAPTER IV

THE INTRODUCTION OF THE CONVOY SYSTEM

THE question of the introduction of convoys for the protection of merchant ships was under consideration at various times during the war. The system had been employed during the old wars and had proved its value in the case of attack by vessels on the surface, and it was natural that thoughts should be directed towards its re-introduction when the submarine campaign developed. There is one inherent disadvantage in this system which cannot be overcome, although it can be mitigated by careful organization, viz. the delay involved. Delay means, of course, a loss of carrying power, and when tonnage is already short any proposal which must reduce its efficiency has to be very carefully examined. The delay of the convoy system is due to two causes, (a) because the speed of the convoy must necessarily be fixed by the speed of the slowest ship, and (b) the fact that the arrival of a large number of ships at one time may cause congestion and consequent delay at the port of unloading. However, if additional safety is given there is compensation for this delay when the risk is great. One danger of a convoy system under modern conditions should be mentioned, viz. the increased risk from attack by mines. If ships are sailing singly a minefield will in all probability sink only one vessel—the first ship entering it. The fate of that ship reveals the presence of the field, and with adequate organization it is improbable that other vessels will be sunk in the same field. In the case of a convoy

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encountering a minefield, as in the case of a fleet, several ships may be sunk practically simultaneously.

During the year 1916, whilst I was still in command of the Grand Fleet, suggestions as to convoys had been forwarded to the Admiralty for the better protection of the ocean trade against attack by surface vessels; but it was pointed out to me that the number of cruisers available for escort work was entirely insufficient, and that, consequently, the suggestions could not be adopted. This objection was one that could only be overcome by removing some of the faster merchant ships from the trade routes and arming them. To this course there was the objection that we were already—that is before the intensive campaign began—very short of shipping.

Shortly after my taking up the post of First Sea Lord at the Admiralty, at the end of 1916, the question was discussed once more. At that time the danger of attack by enemy raiders on shipping in the North Atlantic was small; the protection needed was against attack by submarines, and the dangerous area commenced some 300-400 miles from the British Islands. It was known that unrestricted submarine warfare was about to commence, and that this would mean that shipping would usually be subjected to torpedo attack from submarines when in a submerged condition. Against this form of attack the gun armament of cruisers or armed merchant ships was practically useless, and, however powerfully armed, ships of this type were themselves in peril of being torpedoed. Small vessels of shallow draught, possessing high speed, offered the only practicable form of protection. Shallow draught was necessary in order that the protecting vessels should themselves be comparatively immune from successful torpedo fire, and speed was essential for offensive operations against the submarines.

Convoy sailing was, as has been stated, the recognized method of trade protection in the old wars, and this was a strong argument in favour of its adoption in the late war. It should, however, be clearly understood that the conditions had entirely changed. Convoy sailing for the protection of merchant ships against torpedo attack by submarines was quite a different matter from such a system as a preventive against attack by surface vessels and involved far greater difficulties. In the days of sailing ships especially, accurate station keeping was not very necessary, and the ships comprising the convoy sailed in loose order and covered a considerable area of water. On a strange vessel, also a sailing vessel, being sighted, the protecting frigate or frigates would proceed to investigate her character, whilst the ships composing the convoy closed in towards one another or steered a course that would take them out of danger.

In the circumstances with which we were dealing in 1917 the requirements were quite otherwise. It was essential for the protection of the convoy that the ships should keep close and accurate station and should be able to manœuvre by signal. Close station was enjoined by the necessity of reducing the area covered by the convoy; accurate station was required to ensure safety from collision and freedom of manœuvre. It will be realized that a convoy comprising twenty to thirty vessels occupies considerable space, even when steaming in the usual formation of four, five or six columns. Since the number of destroyers or sloops that could be provided for screening the convoy from torpedo attack by submarines was bound to be very limited under any conditions, it was essential that the columns of ships should be as short as possible; in other words, that the ships should follow one another at close intervals, so that the destroyers on each

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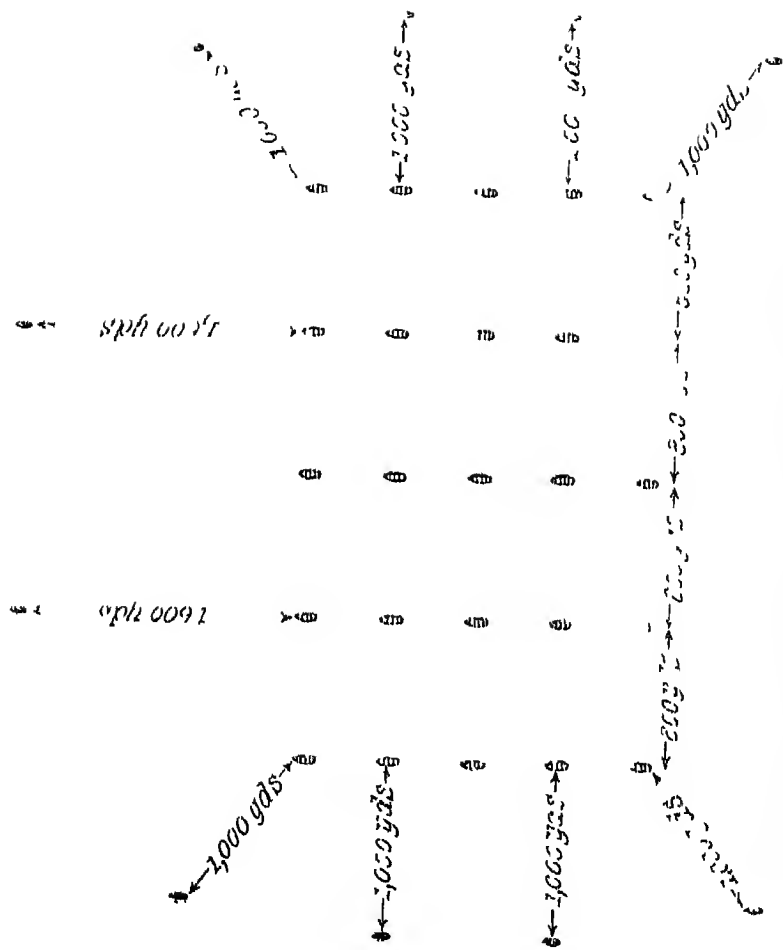
side of the convoy should be able as far as possible to guard it from attack by submarines working from the flank, and that they should be able with great rapidity to counter-attack a submarine with depth charges should a periscope be sighted for a brief moment above the surface, or the track of a torpedo be seen. In fact, it was necessary, if the protection of a convoy was to be real protection, that the ships composing the convoy should be handled in a manner that approached the handling of battleships in a squadron. The diagram on p. 107 shows an ideal convoy with six destroyers protecting it, disposed in the manner ordered at the start of the convoy system.

How far this ideal was attainable was a matter of doubt. Prior to 1917 our experience of merchant ships sailing in company had been confined to troop transports. These vessels were well officered and well manned, carried experienced engine-room staffs, were capable of attaining moderate speeds, and were generally not comparable to ordinary cargo vessels, many of which were of very slow speed, and possessed a large proportion of officers and men of limited sea experience, owing to the very considerable personnel of the Mercantile Marine which had joined the Royal Naval Reserve and was serving in the Fleet or in patrol craft. Moreover, even the troop transports had not crossed the submarine zone in company, but had been escorted independently; and many naval officers who had been in charge of convoys, when questioned, were not convinced that sailing in convoy under the conditions mentioned above was a feasible proposition, nor, moreover, were the masters of the transports.

In February, 1917, in order to investigate this aspect of the question, a conference took place between the Naval Staff and the masters of cargo steamers which were lying in the London docks. The masters were

asked their opinion as to how far their ships could be depended on to keep station in a convoy of 12 to 20 vessels. They expressed a unanimous opinion that it was not practicable to keep station under the conditions mentioned, the difficulty being due to two causes: (1) the inexperience of their deck officers owing to so many of them having been taken for the Royal Naval Reserve, and (2) the inexperience of their engineers, combined with the impossibility of obtaining delicate adjustments of speed by reason of the absence of suitable engine-room telegraphs and the poor quality of much of the coal used. When pressed as to the greatest number of ships that could be expected to manœuvre together in safety, the masters of these cargo steamers, all experienced seamen, gave it as their opinion that two or possibly three was the maximum number. The opinions thus expressed were confirmed later by other masters of merchant ships who were consulted on the subject. It is to the eternal credit of the British Merchant Marine, which rendered service of absolutely inestimable value to the Empire throughout the war, that when put to the test by the adoption of the convoy system, officers and men proved that they could achieve far more than they themselves had considered possible. At the same time it should be recognized how severe a strain was imposed on officers, particularly the masters, of vessels sailing in convoy.

The matter was kept constantly under review. In February, 1917, the Germans commenced unrestricted submarine warfare against merchant ships of all nationalities, and as a consequence our shipping losses, as well as those of Allied and neutral countries, began to mount steadily each succeeding month. The effect of this new phase of submarine warfare is best illustrated by a few figures.



Typical convoy and escort of 10 Travers in the early days of convoy.

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During the last four months of 1916 the gross tonnage lost by *submarine attack* alone gave the following monthly average: British, 121,500; Allies, 59,500; neutrals, 87,500; total, 268,500.

In the first four months of 1917 the figures became, in round numbers:

	<i>British.</i>	<i>Allies.</i>	<i>Neutrals.</i>	<i>Total.</i>
January	104,000	62,000	116,000	282,000
February	256,000	77,000	181,000	464,000
March	288,000	74,000	149,000	506,000
April *	513,000	138,000	185,000	831,000

NOTE.—In neither case is the loss of fishing craft included.

It will be realized that, since the losses towards the end of 1916 were such as to give just cause for considerable anxiety, the later figures made it clear that some method of counteracting the submarines must be found and found quickly if the Allied cause was to be saved from disaster.

None of the anti-submarine measures that had been under consideration or trial since the formation of the Anti-Submarine Division of the Naval Staff in December, 1916, could by *any possibility* mature for some months, since time was necessary for the production of vessels and more or less complicated matériel, and in these circumstances the only step that could be taken was that of giving a trial to the convoy system for the ocean trade, although the time was by no means yet ripe for effective use of the system, by reason of the shortage of destroyers, sloops and cruisers, which was still most acute, although the situation was improving slowly month by month as new vessels were completed.

Prior to this date we had already had some experience of convoys as a protection against submarine attack. The coal trade of France had been brought under convoy in

* The United States entered the war on April 6, 1917.

March, 1917. The trade between Scandinavia and North Sea ports was also organized in convoys in April of the same year, this trade having since December, 1916, been carried out on a system of "protected sailings." It is true that these convoys were always very much scattered, particularly the Scandinavian convoy, which was composed largely of neutral vessels and therefore presented exceptional difficulties in the matter of organization and handling. The number of destroyers which could be spared for screening the convoys was also very small. The protection afforded was therefore more apparent than real, but even so the results had been very good in reducing the losses by submarine attack. The protection of the vessels employed in the French coal trade was entrusted very largely to trawlers, as the ships composing the convoy were mostly slow, so that in this case more screening vessels were available, although they were not so efficient, being themselves of slow speed.

For the introduction of a system of convoy which would protect merchant ships as far as their port of discharge in the United Kingdom, there were two requirements: (a) A sufficient number of convoying cruisers or armed merchant ships, whose rôle would be that of bringing the ships comprising the convoy to some selected rendezvous outside the zone of submarine activity, where it would be met by the flotilla of small vessels which would protect the convoy through the submarine area. It was essential that the ships of the convoy should arrive at this rendezvous as an organized unit, well practised in station-keeping by day, and at night, with the ships darkened, and that the vessels should be capable also of zigzagging together and of carrying out such necessary movements as alterations of course, etc.; otherwise the convoy could not be safely escorted through the danger area. (b) The

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other essential was the presence of the escorting flotilla in sufficient strength.

It has been mentioned that there was an insufficient number of vessels available for use as convoying cruisers. It was estimated that about fifty cruisers or armed merchant ships would be required for this service if the homeward-bound trade to the British Isles alone was considered. An additional twelve vessels would be necessary to deal with the outward-bound trade. At the time only eighteen vessels were available, and these could only be obtained by denuding the North Atlantic entirely of cruisers.

The situation in regard to destroyers or other fast vessels presented equal difficulties. Early in February, 1917, we had available for general convoy or patrol work only fourteen destroyers stationed at Devonport and twelve sloops at Queenstown, and owing to repairs and the necessity of resting officers and men periodically, only a proportion of these were available at any one time. A number of these vessels were required to escort troop transports through the submarine danger zone. During the month of February six sloops were diverted from their proper work of minesweeping in the North Sea and added to the patrol force at Queenstown, and eight destroyers were taken from the Grand Fleet and sent to southern waters for patrol and escort duty. There were obvious objections to this weakening of the North Sea forces, but it was necessary in the circumstances to ignore them.

This total of forty destroyers and sloops represented the whole available force at the end of February. Simultaneously a careful investigation showed that for the institution of a system of convoy and escort for homeward-bound Atlantic trade alone to the United Kingdom, our requirements would be eighty-one destroyers or sloops and

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forty-eight trawlers (the latter vessels being only suitable for escorting the slow 6-7-knot ships of the trade from Gibraltar to the United Kingdom). For the outward Atlantic trade from the United Kingdom our estimated requirements were forty-four additional destroyers or sloops.

The deficiency in suitable vessels of this class is best shown by the following table, which reveals the destroyer position at different periods during the year 1917 :

	Grand Fleet.	Harwich Force.	Dover.	Devonport.	Portsmouth.	The Nore.	Lowestoft.	The Humber.	The Tyne.	Scapa and Invergordon.	North Channel.	Burana.	Queensdown.	Pembro'e.	Mediterranean.
<i>January.</i>															
Flotilla Leaders . . .	10	2	3												
Modern destroyers . .	97†	15	18	14	13										29
Destroyers of River class and earlier construction			11	6	16	9		9	11	15	4				8
P boats		2	5		4	10	4	1							
<i>June.</i>															
Flotilla Leaders . . .	10	3	4												
Modern destroyers . .	95†	23	29	38	15			5					4	32	20
Destroyers of River class and earlier construction			10	5	16	7		29	1	11	4				8
P boats		2	6		8	9	4	1							5
<i>November.</i>															
Flotilla Leaders . . .	11	4	6												
Modern destroyers . .	101*	24	26	37	9			1					29	35	32
Destroyers of River class and earlier construction			10	4	8	12	2	30		11	4				8
P boats		2	6		3	1		1							10

* Includes destroyers detached for protection work in other commands.

† Includes United States destroyers.

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There was the possible alternative of bringing only a small portion of the trade under convoy by taking all the available fast small craft from patrol duty and utilizing them to escort this portion of the trade, but it was felt that as this would leave the *whole* of the remaining trade entirely without protection, and no fast patrol craft would be on the trade routes to pick up the crews of any merchant ships that might be sunk by submarines, the step was not justified.

The next point for consideration was the possibility of obtaining destroyers or sloops from other sources with which to increase the forces for trade protection. The only commands on which it was possible to draw further were the Grand Fleet, the Harwich and Dover forces, the destroyers of old types working on the East Coast, or the destroyers and "P" boats protecting our cross-Channel communications west of the Dover Command.

It was out of the question to reduce the Harwich or Dover flotillas materially, as we were already running the gravest risks from the inadequacy of these forces to deal with enemy destroyers and submarines operating in southern waters from Zeebrugge or from German ports, and in addition the Harwich Force furnished the sole protection for the weekly convoy running between the Thames and Dutch ports, besides being much required for reconnaissance and offensive operations in the Heligoland Bight so far as it could be spared for this purpose. However, the emergency was such that destroyers were taken from Harwich, as the force obtained new vessels of a faster and more powerful type. The destroyers on the East Coast and in the Portsmouth Command were already inadequate to afford proper protection to the trade and the cross-Channel communications, as evidenced by our losses. Here again, however, in order to meet the

very serious situation, some destroyers were eventually transferred to Devonport from Portsmouth, but at the expense of still less protection and fewer opportunities for offensive action against submarines. There remained only the Grand Fleet destroyers on which we could draw yet further. It had always been held that the Grand Fleet required a total force of one hundred destroyers and ten flotilla leaders for the double purpose of screening the ships from submarine attack when at sea and of countering the enemy's destroyers and attacking his heavy ships with torpedo fire in a fleet action. We had gradually built the destroyer force of the Grand Fleet up to this figure by the early spring of 1917, although, of course, it fell far short of requirements in earlier months. It was well known to us that the High Sea Fleet would be accompanied by at least eight flotillas, or eighty-eight destroyers, when proceeding to sea at its *selected* moment, and it was quite probable that the number might be much higher, as many more vessels were available. At our *average* moment, even with a nominal force of one hundred destroyers and ten flotilla leaders, we could not expect that more than seventy destroyers and eight leaders would be present with the Fleet, since, in addition to those absent refitting, a considerable number were always engaged on trade protection or anti-submarine work in northern waters which could not join up in time to accompany the Fleet to sea. When the Scandinavian convoy was started in April, 1917, one flotilla leader and six destroyers from the Grand Fleet were used for its protection; other vessels in northern waters also depended on Grand Fleet destroyers for protection. Any further transference, therefore, of destroyers from the Grand Fleet to southern waters for trade protection was a highly dangerous expedient, involv-

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ing increased risk from submarine attack on the heavy ships in the event of the Fleet proceeding to sea, as well as disadvantages in a Fleet action. The necessity, however, was so great that the risk had to be faced, and for some months of 1917 from eight to twelve Grand Fleet destroyers were used for trade protection in the Atlantic, principally from Irish ports, in addition to those protecting trade in the North Sea.

It is interesting to note the number of persons who claim to have been the first to urge the Admiralty to adopt convoys as a method of protecting merchant ships against submarine attack. The claimants for this distinction are not confined to Great Britain; the great majority of them are people without any knowledge of the sea and naval matters, certainly none of them possessed any knowledge of the number of vessels needed to afford protection to the ships under convoy, nor of the vessels which we could produce for the purpose at the time.

Possibly the facts related above may serve to show that convoys were commenced by Admiralty direction, and that they were started as soon as and extended as rapidly as the necessary protecting vessels could be provided. Those who argued then, or who have argued since, that we should have reduced the number of destroyers with the Grand Fleet will not, I think, meet with any support from those who served in that Fleet, especially from the officers upon whom lay the responsibility for countering any move of the High Sea Fleet.

The entry of the United States into the war early in April eased the situation somewhat. First it was hoped that the United States Navy would assist us with destroyers and other small craft, and secondly it was a fact that the great majority of the material imported into

countries contiguous to Germany came from the United States. There was reason to anticipate that steps would be taken by the United States authorities in the direction of some form of rationing of these countries, and in these circumstances it was justifiable to reduce gradually the strength of our blockading squadron of armed merchant vessels known as the 10th Cruiser Squadron. By this means we could at once provide additional vessels to act as convoying cruisers.

Vice-Admiral W. S. Sims had arrived in this country in March, 1917, after passing through an exciting experience, the ship in which he crossed (the United States steamer *St. Louis*) being mined outside Liverpool. He came to visit me at the Admiralty immediately after his arrival in London, and from that day until I left the Admiralty at the end of the year it was my privilege and pleasure to work in the very closest co-operation with him. My friendship with the Admiral was of very long standing. We had during many years exchanged views on different naval subjects, but principally on gunnery questions. I, in common with other British naval officers who had the honour of his acquaintance, had always been greatly struck by his wonderful success in the post of Inspector of Target Practice in the United States Navy. That success was due not only to his intimate knowledge of gunnery, but also to his attractive personality, charm of manner, keen sense of humour, and quick and accurate grasp of any problem with which he was confronted. It was fortunate indeed for the Allied cause that Admiral Sims should have been selected to command the United States forces in European waters, for to the qualities mentioned above he added a habit of speaking his mind with absolutely fearless disregard of the consequences. This characteristic has led him on more than one occasion into

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difficulty, but in the circumstances with which we had to deal in 1917 it was just the quality that was needed. It was a very difficult matter for those in authority in the United States, separated as they were by 3,000 miles of sea from the theatres of war, to realize the conditions in European waters, for the Admiralty was not concerned only with the North Sea and Atlantic, and the terse and straightforward reports of Admiral Sims, and his convincing statements, went a long way towards bringing home to the United States people at that time the extreme gravity of the situation and the need for immediate action. He was consistently backed up by that great ambassador, the late Mr. W. H. Page, who also honoured me with his confidence, and to whom I spoke perfectly freely on all occasions.

The assistance from the United States that it was hoped was now in sight made the prospect of success following on the adoption of the convoy system far more favourable, and preparations were put in hand for the institution of an ocean convoy system on a large scale. In order to gain some experience of the difficulties attending the working of cargo ships, directions were given for an experimental convoy to be collected at Gibraltar. The necessary officers were sent out to Gibraltar with orders to assemble the convoy, to instruct the masters in the work that lay before them, and to explain to them the system of sailing, the manner in which the convoy would be handled, and the protection that would be afforded. This naturally took time, and the convoy did not arrive in England until after the middle of May. The experience gained showed, however, that the difficulties apprehended by the officers of the Mercantile Marine were not insuperable, and that, given adequate protection by cruisers and small fast craft, the system was at least practicable.

It was accordingly decided to put it into operation at once, and to extend it as rapidly as the increase in the numbers of our destroyers and sloops permitted.

The North Atlantic homeward-bound trade was brought under convoy in May, 1917, and the Gibraltar homeward-bound trade in July, but for some months it was impossible to provide for the institution of a complete convoy system. At first some 40 per cent. of the homeward-bound trade was convoyed. Then the system was gradually extended to include first 60 per cent., then 80 per cent., and finally 100 per cent. of the homeward Atlantic trade and the trade from Gibraltar, trawlers being used as escorts for the Gibraltar trade, as the majority of the ships therein engaged were slow. But trawlers are unsatisfactory escort vessels.

In the early stages of the convoy system difficulties were experienced from the fact that all the available destroyers and most of the sloops were used as escorts, with the result that the ships not under convoy were left with but little protection.

CHAPTER V

THE CONVOY SYSTEM AT WORK

As has been mentioned in Chapter II., the first ships to be brought under a system of convoy were those engaged in the French coal trade and in the trade between Scandinavia and the United Kingdom.

In the case of the *French coal trade*, commencing in March, 1917, the steamships engaged in the trade were sailed in groups from four different assembly ports, viz. :

Southend to Boulogne and Calais.
St. Helens to Havre.
Portland to Cherbourg.
Penzance to Brest.

Between Southend and Boulogne and Calais the protection was given by the vessels of the Dover Patrol in the course of their ordinary duties, but for the other three routes special escort forces were utilized, and daily convoys were the rule.

Owing to the great demand for coal in France, sailing vessels were also used, and sailed under convoy from several of the south-west ports.

A large organization was required to deal with the trade, and this was built up under the supervision of Captain Reginald G. H. Henderson, C.B., of the Anti-Submarine Division of the Naval Staff, working under Vice-Admiral (then Rear-Admiral) Sir Alexander Duff, head of the Division, in conference with the Com-

manders-in-Chief, Portsmouth and Plymouth, under whose direction and protection the convoys were run. The immunity of this trade, carried out in the infested waters of the English Channel, from successful attack by submarines was extraordinary. No doubt the small size of the vessels concerned and their comparatively shallow draught were a contributory cause to this immunity. The figures for the period March to August, 1917, show that 8,825 vessels crossed the Channel under convoy, and that only fourteen were lost.

The history of the *Scandinavian and East Coast convoys* dates back to the autumn of 1916, when heavy losses were being incurred amongst Scandinavian ships due to submarine attack. Thus in October, 1916, the losses amongst Norwegian and Swedish ships by submarine attack were more than three times as great as the previous highest monthly losses. Some fear existed that the neutral Scandinavian countries might refuse to run such risks and go to the extreme of prohibiting sailings. Towards the end of 1916, before I left the Fleet, a system of "protected" sailings was therefore introduced. In this system the Commander-in-Chief, Grand Fleet, fixed upon a number of alternative routes between Norway and the Shetland Islands, which were used by all vessels trading between Scandinavia and Allied countries. The particular route in use at any given moment was patrolled by the local forces from the Orkneys and Shetlands, assisted when possible by small craft from the Grand Fleet. The Admiral Commanding the Orkneys and Shetlands was placed in charge of the arrangements, which were carried out by the Senior Naval Officer at Lerwick, in the Shetland Islands. At this period the intention was that the shipping from Norway should sail at dusk, reach a certain

rendezvous at dawn, and thence be escorted to Lerwick. The shipping from Lerwick sailed at dawn under protection, dispersed at dark, and reached the Norwegian coast at dawn. Difficulties, of course, arose in the event of bad weather, or when the slow speed of the ships prevented the passage of about 180 miles being made in approximately twenty-four hours, and by April, 1917, it was evident that further steps were necessary to meet these difficulties, which were again causing heavy losses. Early in April, then, by direction from the Admiralty, a conference was held at Longhope on the subject. Admiral Sir Frederick Brock, Commanding the Orkneys and Shetlands, presided, and representatives from the Admiralty and the Commands affected were present, and the adoption of a complete convoy system to include the whole trade between the East Coast and Norway was recommended. This proposal was approved by the Admiralty and was put into force as soon as the necessary organization had matured. Escorting vessels had with difficulty been provided, although in inadequate numbers. The first convoys sailed towards the end of April, 1917.

The system may be described briefly as follows. The convoys all put into Lerwick, in the Shetland Islands, both on the eastward and westward passages, so that Lerwick acted as a junction for the whole system. From Lerwick, convoys to Scandinavia left in the afternoon under the protection of two or three destroyers, and, with some armed patrol vessels in company up to a certain stage, made the Norwegian coast at varying points, and there dispersed, and the destroyers then picked up the west-bound convoy at a rendezvous off the Norwegian coast shortly before dark, and steered for a rendezvous between Norway and the Shetland Islands, where an escort of armed patrol vessels joined the convoy at daylight

to assist in its protection to Lerwick. From Lerwick convoys were dispatched to various points on the coast of the United Kingdom; those making for southern ports on the East Coast were escorted by a force composed of some of the old "River" class or of 30-knot class destroyers, and trawlers belonging to the East Coast Command based on the Humber, and those making for more northerly ports or ports on the West Coast were escorted merely by armed patrol vessels, as the danger of submarine attack to these convoys was not so great.

The main difficulty was the provision of the destroyers required for the proper protection of the convoys, and to a lesser degree the provision of armed patrol vessels of the trawler, whaler, or drifter types.

The conference held early in April, 1917, had reported that whilst stronger protection was naturally desirable, the very least force that could give defence to the convoys between Lerwick and the East Coast ports would be a total of twenty-three destroyers and fifty trawlers, whilst for each convoy between Lerwick and Norway at least two destroyers and four trawlers were needed. The destroyers for the latter convoys were provided by the Grand Fleet, although they could ill be spared. The total number so utilized was six. It was only possible to provide a force of twenty old destroyers and forty-five trawlers for the East Coast convoys instead of the numbers recommended by the conference, and owing to the age of a large majority of these destroyers and the inevitable resultant occasional breakdown of machinery, the number available frequently fell below twenty, although it was really marvellous how those old destroyers stuck to the work to the eternal credit of their crews, and particularly the engineering staffs. The adoption of the system, however, resulted during the comparatively fine summer

weather in a considerable reduction in the number of merchant ships lost, in spite of the fact that great difficulty was experienced in keeping the ships of the convoys together, particularly at night, dawn frequently finding the convoy very much scattered.

It became obvious, however, that with the approach of winter the old destroyers of the 80-knot class would have the greatest difficulty in facing the heavy weather, and very urgent representations were made by Sir Frederick Brock for their replacement by more modern vessels before the winter set in. All that could be effected in this direction was done, though at the expense of some of the Channel escorts. Urgent requests for good destroyers were being received at the Admiralty from every Command, and it was impossible to comply with them since the vessels were not in existence.

Certain other steps which may be enumerated were taken in connection with the Scandinavian traffic.

The convoys received such additional protection as could be given by the airships which were gradually being stationed on the East Coast during the year 1917, and decoy ships occasionally joined the convoys in order to invite submarine attack on themselves. This procedure was indeed adopted on all convoy routes as they were brought into being, the rule being for the decoy ship to drop behind the convoy in the guise of a straggler.

Some of our submarines were also detailed to work in the vicinity of convoy routes in order that they might take advantage of any opportunity to attack enemy submarines if sighted; due precautions for their safety were made.

Among the difficulties with which the very energetic and resourceful Admiral Commanding the Orkneys and Shetlands had to contend in his working of the convoys

was the persistent mining of the approach to Lerwick Harbour by German submarines; a second difficulty was the great congestion that took place in that harbour as soon as bad weather set in during the autumn of 1917. The weather during the latter part of 1917 was exceptionally bad, and great congestion and consequent delay to shipping occurred both at Lerwick and in the Norwegian ports. As the result of this congestion it became necessary to increase largely the number of ships in each convoy, thereby enhancing the difficulty of handling the convoy.

At the commencement it had been decided to limit the size of a Scandinavian convoy to six or eight vessels, but as the congestion increased it became necessary to exceed this number considerably, occasional convoys composed of as many as thirty to forty ships being formed. A contributory cause to the increase in the size of convoys was due to the fact that the trade between Lerwick and the White Sea, which had been proceeding direct between those places during the first half of 1917, became the target of persistent submarine attack during the summer, and in order to afford them protection it was necessary in the autumn to include these ships also in the Scandinavian convoy for the passage across the North Sea. Between the coast of Norway and the White Sea they proceeded independently, hugging territorial waters as far as possible.

It will be realized that the institution of the convoy system of sailing for the Scandinavian trade necessitated an extensive organization on the Norwegian as well as on the British side of the North Sea. For this reason Captain Arthur Halsey, R.N., was appointed in March, 1917, as Naval Vice-Consul at Bergen, and the whole of the arrangements in regard to the working of the

convoys, the issue of orders, etc., from the Norwegian side came under him and his staff, to which additions were made from time to time. The position was peculiar in that British naval officers were working in this manner in a neutral country, and it says much for the discretion and tact of Captain Halsey and his staff and the courtesy of the Norwegian Government officials that no difficulties occurred.

Steps were also taken to appoint officers at British ports for the work of controlling the mercantile traffic, and as the organization became perfected so the conditions gradually improved.

By the end of September the bad weather prevalent in the North Sea had caused great dislocation in the convoy system. Ships composing convoys became much scattered and arrived so late off Lerwick as to prevent them proceeding on their passage without entering harbour. Owing to the overcrowding of Lerwick Harbour the system of changing convoy escorts without entering harbour had been introduced, and the delays due to bad weather were causing great difficulties in this respect. The question of substituting the Tyne for Lerwick as the collecting port was first discussed at this period, but the objections to the Tyne as an assembly port were so strong as to prevent the adoption of the proposal.

The system of convoy outlined above continued in force from April to December, 1917, during which period some 6,000 vessels were convoyed between Norway and the Humber with a total loss of about seventy ships.

There was always the danger that Germany would attack the convoys by means of surface vessels. The safeguard against such attacks was the constant presence of forces from the Grand Fleet in the North Sea. In

view of the fact, however, that the distance of the convoy routes from the Horn Reef was only between 300 and 350 miles, and that on a winter night this distance could almost be covered at a speed of 20 knots during the fourteen or fifteen hours of darkness that prevailed, it will be seen that unless the convoys were actually accompanied by a force sufficient to protect them against operations by surface vessels, there was undoubted risk of successful attack. It was not possible to forecast the class of vessels by which such an attack might be carried out or the strength of the attacking force. The German decision in this respect would naturally be governed by the value of the objective and by the risk to be run. Admiral Scheer in his book states that on one occasion, in April, 1918, the German battle-cruisers, supported by the battleships and the remainder of the High Sea Fleet, attempted such an attack, but found no convoy. It was always realized by us that an attack in great force might be made on the convoy, but such risk had to be accepted.

The movements of the ships of the Grand Fleet were a matter for the Commander-in-Chief, provided always that no definite orders were issued by the Admiralty or no warning of expected attack was given to the Commander-in-Chief, and, prior to the first attack on the Scandinavian convoy, no special force of cruisers or light cruisers accompanied the convoy to guard it against attack by surface vessels, although a strong deterrent to attack lay in the frequent presence of forces from the Grand Fleet to the southward of the convoy routes, which forces would seriously threaten the return of any raiding German vessels. As the enemy would naturally make the northward passage by night we could hardly expect to sight his ships on the outward trip.

The first attack took place at daylight on October

17. The convoy on this occasion consisted of twelve ships, two British, one Belgian, one Danish, five Norwegian and three Swedish, and was under the anti-submarine escort of the destroyers *Mary Rose* and *Strongbow*, and two trawlers, the *Elsie* and *P. Fannon*. At dawn, shortly after 6.0 A.M., two strange vessels were sighted to the southward, and were later recognized as German light cruisers. They were challenged, but replied by opening fire at about 6.15 A.M., disabling the *Strongbow* with the first salvo fired. The *Mary Rose* steamed gallantly at the enemy with the intention of attacking with torpedoes, but was sunk by gunfire before she could achieve her object. The enemy vessels then attacked the convoy, sinking all except the British and Belgian vessels, which escaped undamaged. The *Strongbow*, shelled at close range, returned the fire, using guns and torpedoes, but was completely overwhelmed by the guns of the light cruisers and sank at about 9.30 A.M. The trawler *Elsie* effected very fine rescue work amongst the survivors both from the *Strongbow* and ships of the convoy, whilst under fire, and both trawlers reached Lerwick. The enemy sheered off soon after 8.0 A.M. Most unfortunately neither the *Strongbow* nor the *Mary Rose* succeeded in getting a wireless signal through to our own vessels to report the presence of enemy ships, otherwise there can be little doubt that they would have been intercepted and sunk. We had in the North Sea, during the night before the attack and during the day of the attack, a particularly strong force of light cruisers comprising four or possibly five* squadrons (a total of not less than sixteen vessels), all to the southward of the convoy route, and had the informa-

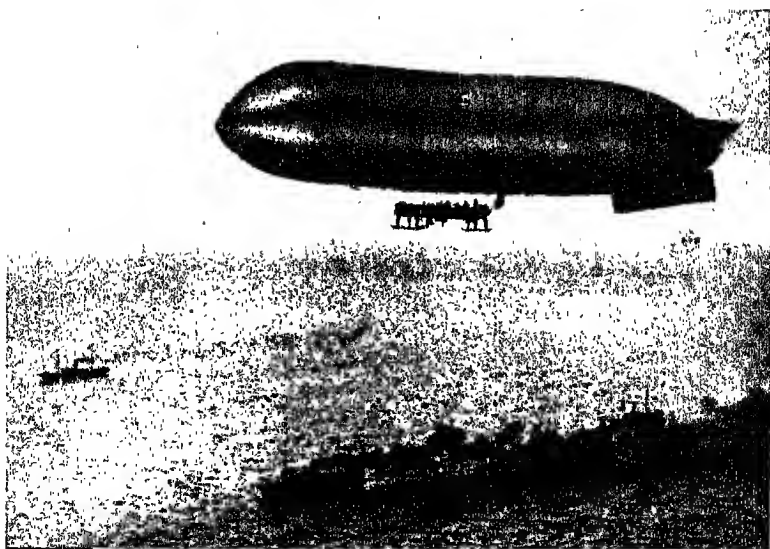
* At this distance of time I do not recollect whether the number of squadrons was four or five.—J.

tion of the attack come through from the destroyers, these vessels would have been informed at once and would have had an excellent chance of intercepting the enemy. The extreme difficulty of preventing the egress of raiders from the North Sea at night, even when so large a force is cruising, was well illustrated by this incident, although a little reflection on the wide area of water to be covered, together with a knowledge of the distance that the eye can cover on a dark night (some 200 to 300 yards), would show how very great are the chances in favour of evasion.

This disaster to the Scandinavian convoy was bound to bring into prominence the question of affording to it protection against future attacks by surface vessels, for necessarily the protection against surface vessels differed from that against submarines, a point which was sometimes overlooked by those who were unfamiliar with the demands of the two wars which were being waged—the one on the surface and the other under the surface. It was very difficult to furnish efficient protection against the surface form of attack from the resources of the Grand Fleet if the practice of running a daily convoy was continued, because it was impossible to forecast the strength or exact character—battle-cruisers, cruisers or destroyers—of the attack; and the first step was to reduce the number of convoys and to increase correspondingly the number of ships in each convoy. A telegram was sent to the Admiral Commanding the Orkneys and Shetlands on October 26 asking whether the convoys could be conveniently reduced to three per week. A reply was received on the 29th to the effect that the convoy could be run every third day under certain conditions; the important conditions were the use of the Tyne instead of the Humber as a collecting port, and the provision of eight extra trawlers and nine modern destroyers. Sir



A Convoy Zigzagging.
(Taken from the Air.)



A Convoy with an Airship.

Frederick Brock stated that he was assuming cruiser protection to the convoys and that the details would need to be worked out before the change could be made. He suggested a conference. He was requested on October 31 to consult the Vice-Admiral Commanding East Coast of England as to the practicability of using the Tyne as a convoy collecting port. Meanwhile Sir F. Brock had prepared a scheme for giving effect to his proposals, and on November 5 he sent copies of this scheme to the Vice-Admiral Commanding East Coast of England and other officers concerned for their consideration.

In forwarding proposals to the Admiralty on November 22, the Commander-in-Chief of the Grand Fleet stated that the destroyers asked for could not be provided from the Grand Fleet. Amongst other reasons it was pointed out that the destroyers required for screening the light cruisers protecting the convoys would have to be supplied from that source, thus bringing an additional strain on the Grand Fleet flotillas. He suggested the provision of these vessels from other Commands, such as the Mediterranean, and pointed out the manifest advantages that would result from providing a force for this convoy work that would be additional to the Grand Fleet flotillas. Consideration of the proposals at the Admiralty showed once again the great difficulty of providing the destroyers. It was impossible to spare any from the Mediterranean, where large troop movements needing destroyer protection were in progress, and other Commands were equally unable to furnish them. Indeed, the demands for destroyers from all directions were as insistent as ever. The unsuitability of the Tyne as a collecting port was remarked upon by the Naval Staff, as well as other objections to the scheme as put forward from Scapa. In order to decide upon a workable scheme,

directions were given that a conference was to assemble at Scapa on December 10. An officer from the Naval Staff was detailed to attend the conference, to point out the objections which had been raised and, amongst other matters, to bring to notice the advantage of the Firth of Forth as a collecting port instead of the Tyne.

Meanwhile steps had been taken to furnish as much protection as possible from Grand Fleet resources to the convoys against attack by enemy surface vessels.

The conference of December 10 came to the conclusion that the Firth of Forth was the best assembly place, and that the port of Methil in that locality would offer great advantages. The conference made recommendations as to the provision of destroyers as soon as they were available, and, amongst other matters, mentioned the necessity for an increase in the minesweeping force at Rosyth to meet a possible extension of enemy minelaying when the new system was in operation.

On December 12 a second attack on the convoy took place. In this instance the attack was carried out by four German destroyers. Two convoys were at sea, one east-bound and one west-bound, the east-bound convoy being attacked. It was screened against submarine attack by two destroyers—the *Pellaw* and *Partridge*—and four armed trawlers, and comprised six vessels, one being British and the remainder neutrals. The attack took place in approximately Lat. 59.50 N., Long. 8.50 E., and the action resulted in the *Partridge*, the four trawlers, and the whole of the convoy being sunk, and the *Pellaw* was so severely damaged as to be incapable of continuing the action. At the time of this attack a west-bound convoy was at sea to the westward of the other convoy, and two armoured cruisers—the *Shannon* and *Minotaur*—with four destroyers were acting as a covering force for the convoys

against attack by surface vessels. A wireless signal from the *Partridge* having been intercepted, this force steamed at full speed for the scene of the action, the destroyers arriving in time to pick up 100 survivors from the convoy and trawlers, but not in time to save the convoy. The 3rd Light Cruiser Squadron, also at sea, was some 85 miles to the southward and eastward of the convoy when attacked, but neither this force nor the *Shannon's* force succeeded in intercepting the enemy before he reached port. The short hours of daylight greatly facilitated his escape.

On receipt of the report of the meeting of December 10, and in view of the attack of December 12, the question of the interval between convoys was specially considered in its relation to the ability of the Grand Fleet to furnish protection against surface attack. It was decided that for this reason it would only be possible to sail convoys from Methil every third day so as to avoid having two convoys at sea at a time, a situation with which the Grand Fleet could not deal satisfactorily. The organization then drawn up actually came into effect on January 20, 1918, after my departure from the Admiralty, and was continued with certain modifications to the end of the war. The principal modification was an increase of the interval between convoys, first, to four, and later to five days in order to relieve the strain on the Grand Fleet arising from the provision of covering forces; the disadvantage of the resultant increased size of the convoys had to be accepted. Under the new system the Commander-in-Chief Coast of Scotland at Rosyth—Admiral Sir Cecil Burney—became responsible for the control of the Scandinavian convoys, the Admiralty selecting the routes.

The introduction of the convoy system for the Atlantic

trade dates from the early days of May, 1917, when the prospect—for it was only then a prospect—of increasing assistance from the U.S. Navy in regard to destroyers and other small craft for escort duty as well as convoy cruisers for ocean work, made the system possible. Action taken with the U.S. authorities for the introduction of a system by which the trade from that country in neutral shipping was controlled enabled the ships of the 10th Cruiser Squadron to be gradually withdrawn from blockade duties and utilized as ocean convoy cruisers. Even with assistance from the U.S. Navy in the shape of old battleships and cruisers, the use of the 10th Cruiser Squadron, the withdrawal of the 2nd Cruiser Squadron of five ships from the Grand Fleet, the use of the ships of the North American and West Indies Squadron and of some of our older battleships from the Mediterranean, there was still a shortage of convoy cruisers; this deficiency was made up by arming a number of the faster cargo vessels with 6-inch guns for duty as convoy cruisers. These vessels usually carried cargo themselves, so that no great loss of tonnage was involved.

On May 17 a committee was assembled at the Admiralty to draw up a complete organization for a general convoy system.* This committee had before it the experience of an experimental convoy which arrived from Gibraltar shortly after the commencement of the committee's work, as well as the experience already gained in the Scandinavian and French coal trade convoys, and the evidence of officers such as Captain R. G. Henderson, R.N., who had made a close study of the convoy question.

On June 6 the report was completed. This valuable

* The committee was composed of the following officers:

Captain H. W. Longden, R.N.	Fleet Paymaster H. W. E. Manisty, R.N.
Commander J. S. Wilde, R.N.	Lieutenant G. E. Burton, R.N., and
Mr. N. A. Leslie, of the Ministry of Shipping.	

report dealt with the whole organization needed for the institution of a complete system of convoy for homeward and outward trade in the Atlantic. In anticipation of the report steps had already been taken to commence the system, the first homeward bound Atlantic convoy starting on May 24. A necessary preliminary for the successful working of the convoys was a central organization at the Admiralty. This organization—termed the Convoy Section of the 'Trade Division of the Naval Staff—worked directly under Rear-Admiral A. L. Duff, who had recently been placed on the Board of Admiralty with the title of Assistant Chief of the Naval Staff (A.C.N.S.), and who was in immediate control of the Anti-Submarine, Trade and Minesweeping Divisions of the Staff. Fleet Paymaster H. W. E. Manisty was appointed as Organizing Manager of Convoys, and the Convoy Section, comprising at first some ten officers, soon increased to a total of fifteen, and was in immediate touch with the Ministry of Shipping through a representative, Mr. Leslie. His function was to make such arrangements as would ensure co-operation between the loading and discharging of cargoes and convoy requirements, and generally to co-ordinate shipping needs with convoy needs.

The organizing manager of the convoys and his staff controlled the assembly, etc., of all convoys and vessels.

The routing of the convoys and their protection, both ocean and anti-submarine, was arranged under the superintendence of the A.C.N.S.

In addition to the central Admiralty organization, an officer with the necessary staff was appointed to each convoy port of assembly at home and abroad. This officer's duties comprised the collection and organization of the convoy and the issue of sailing orders and necessary printed instructions to the masters of the vessels, seeing

that they were properly equipped for sailing in company, and forwarding information to the Admiralty of the movements of the convoy.

An essential feature of the system was the appointment of a convoy commodore. This officer was quite distinct from the commanding officer of the vessel forming the ocean escort, but acted under his orders when in company. The duty of the convoy commodore, whose broad pennant was hoisted in one of the ships, was, subject to instructions from the commanding officer of the escorting vessel, to take general charge of the convoy.

The convoy commodores were either naval officers, admirals or captains on the active or retired lists, or experienced merchant captains. The duties were most arduous and responsible, but there was no lack of volunteers for this work. Many of the convoy commodores had their ships sunk under them. The country has every reason for much gratitude to those who undertook this difficult and very responsible task.

By July we had succeeded in increasing the strength of the anti-submarine convoy escorting force to thirty-three destroyers (eleven of which belonged to the United States Navy) and ten sloops, with eleven more destroyers for the screening of troop transports through the submarine zone and for the protection of the convoys eastward from the Lizard, the position in which the other screening force left them. We had remaining twelve sloops, which, with trawlers, were engaged in protecting that considerable portion of the trade making for the south of Ireland, which we could not yet bring under convoy. It was intended to absorb these sloops for convoy protection as soon as circumstances permitted.

At this stage it was considered that a total of thirty-three more destroyers or sloops was needed to complete

the homeward convoy system. The Admiralty was pressed to weaken yet further the Grand Fleet destroyer force in order to extend the convoy system, but did not consider such a course justified in view of the general naval situation.

In arranging the organization of the Atlantic convoy system it was necessary to take into consideration certain other important matters. Amongst these were the following :

1. The selection of ports of assembly and frequency of sailing. During the latter half of 1917 the general arrangements were as follows for the homeward trade :

<i>Port of Assembly.</i>	<i>Frequency of Sailing.</i>	<i>Destination.</i>
Gibraltar	Every 4 days.	Alternately to E. & W. c'ts.
Sierra Leone	,, 8 ,,	Either coast.
Dakar	,, 8 ,,	Either coast.
Hampton Roads (U.S.A.)	,, 4 ,,	Alternately to E. & W. c'ts.
New York	,, 8 ,,	Ditto.
Halifax, N.S.	,, 8 ,,	West coast.
Sydney (Cape Breton) ...	,, 8 ,,	Alternately to E. & W. c'ts.

Each port served a certain area of trade, and vessels engaged in that trade met at the port of assembly for convoy to the United Kingdom or to France.

The total number of merchant ships sailing thus in convoy every eight days in September, 1917, was about 150, in convoys comprising from 12 to 30 ships, and the total escorting forces comprised :

50 ocean escort vessels (old battleships, cruisers, armed merchant ships and armed escort ships),

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90 sloops and destroyers,

15 vessels of the "P" class (small destroyers),

50 trawlers,

in addition to a considerable force for local escort near Gibraltar, consisting of sloops, yachts, torpedo boats, U.S. revenue cruisers, U.S. tugs, etc.

At this period (September, 1917) outward convoys were also in operation, the arrangement being that the outward convoy was escorted by destroyers or sloops to a position 300 to 400 miles from the coast clear of the known submarine area, and there dispersed to proceed independently, there being insufficient ocean escort vessels to take the convoy on; about twelve more were needed for this work. The escorting vessels used for the outward convoys were destroyers or sloops which were due to proceed to sea to meet a homeward convoy, the routine being that the outward convoy should sail at such a time as would ensure the homeward convoy being met by the escort without undue delay at the rendezvous, since any long period of waiting about at a rendezvous was impossible for the escorting vessels as they would have run short of fuel. It was also undesirable, as it revealed to any submarine in the neighbourhood the approach of a convoy.

It will be realized by seamen that this procedure (which was forced upon us by the shortage of escorting vessels) led to many difficulties. In the first place the homeward convoys were frequently delayed by bad weather, etc., on passage across the Atlantic, and, owing to the insufficient range of the wireless installations, it was often not possible for the commodore to acquaint the Admiralty of this delay in time to stop the sailing of the outward convoys. Again, outward convoys were often delayed by bad weather, resulting in the homeward con-

voy not being met before entering the submarine zone. As the winter drew near this was a source of constant anxiety, since so many of the vessels outward bound were in ballast (empty), and their speed was consequently quickly reduced in bad weather. The ships under these conditions became in some cases almost unmanageable in a convoy, and the responsibilities of the escorts were much intensified.

In September, 1917, the following was the position in respect to outward bound convoys:

<i>Port of Assembly.</i>		<i>Frequency of Sailing.</i>	<i>Destination.</i>
Lamlash	... ..	Every 4 days.	Atlantic ports.
Milford Haven	... ..	„ 4 „	Gibraltar.
Queenstown	... ..	„ 4 „	Atlantic ports.
Falmouth	... ..	„ 8 „	Gibraltar.
Plymouth	... ..	„ 4 „	Atlantic ports.

About 150 vessels sailed every eight days in convoys varying in strength from 12 to 30 ships.

There was still a good deal of Atlantic trade that was not sailing under convoy. This comprised trade between Gibraltar and North and South America, between the Cape, South America and Dakar, and the coastal trade between North and South America. It was estimated that an additional twenty-five to thirty ocean escorts and eleven destroyers would be needed to include the above trade in convoy.

The Mediterranean trade is dealt with later.

The question of speed was naturally one of great importance in the convoy system. As has been stated earlier, the speed of a convoy like that of a squadron or fleet is necessarily that of the slowest ship, and in order to prevent delay to shipping, which was equivalent to serious loss of its carrying power, it was very necessary that convoys should be composed of ships of approximately

the same speed. In order to achieve this careful organization was needed, and the matter was not made easier by the uncertainty that frequently prevailed as to the actual sea speed of particular merchant ships. Some masters, no doubt from legitimate pride in their vessels, credited them with speeds in excess of those actually attained. Frequently coal of poor quality or the fact that a ship had a dirty bottom reduced her speed to a very appreciable extent, and convoy commanders had occasionally to direct ships under such conditions to drop out of the convoy altogether and make their passage alone. Obviously this action was not taken lightly owing to the risk involved. Decision as to the sea speed of convoys was taken by the convoy officer at the collecting port, and he based this on the result of an examination of the records in the different ships. As a rule convoys were classed as "slow" and "fast." Slow convoys comprised vessels of a speed between 8 and $12\frac{1}{2}$ knots. Fast convoys included ships with a speed between $12\frac{1}{2}$ and 16 knots. Ships of higher speed than 16 knots did not as a rule sail in convoys, but trusted to their speed and dark hours for protection in the submarine area. The Gibraltar convoy (an exception to the general rule) contained ships of only 7 knots speed.

With the introduction of convoys the provision of efficient signal arrangements became a matter of importance. The issue of printed instructions to each master and the custom introduced of assembling the masters to meet the captain of the escorting cruiser before sailing, so that the conduct of the convoy might be explained, had the effect of reducing signalling to a minimum, but it was necessary that each ship should have a signalman on board, and the provision of the number of signalmen required was no easy matter. A good wire-

less installation was essential in the escorting cruiser and in the Commodore's ship in order that the course of the convoy could be diverted by the Admiralty if the known or suspected presence of submarines rendered it necessary, and also for the purpose of giving to the Admiralty early information of the position of a convoy approaching the coast, so that the escorting destroyers could be dispatched in time.

Fortunately for us, German submarines constantly used their wireless installations when operating at sea, and as a consequence our wireless directional stations were able to fix their positions by cross bearings. This practice on the part of the enemy undoubtedly went far to assist us both in anti-submarine measures and in diverting trade to a safe course.

The introduction of the convoy system rendered the provision of anti-submarine protection at ports of assembly a matter of great importance, owing to the very large number of vessels that were collected in them. Some of the ports were already in possession of these defences, but amongst those for which net protection was prepared and laid during 1917 were Halifax, Sydney (Cape Breton), Falmouth, Lamlash, Rosslare (on the south-east coast of Ireland), Milford Haven, Sierra Leone and Dakar. This involved extensive work, and was undertaken and carried out with great rapidity by Captain F. C. Learmonth and his staff, whose work in the production of net defences during the war was of inestimable value, not only to ourselves, but to our Allies, for whom large supplies of net defences were also provided. The U.S.A. also adopted our system of net defence for their harbours on entry into the war. Many anxious months were passed at the Admiralty and at the ports named until the anti-submarine defences were completed.

The escort of the convoys through the submarine zone imposed very heavy work upon the destroyers, sloops and other screening vessels. This was due partly to the fact that there were not sufficient vessels to admit of adequate time being spent in harbour to rest the crews and effect necessary repairs, and partly to the nature of the work itself and the weather conditions under which so much of it was carried out. It will be realized by those who have been at sea in these small craft that little rest was obtainable in the Atlantic between the west coast of Ireland and the mouth of the Channel and positions 300 to 400 miles to the westward, except in the finest weather. When to this is added the constant strain imposed by watching for the momentary appearance of a periscope or the track of a torpedo, and the vigilance needed, especially on dark and stormy nights, to keep touch with a large convoy of merchant ships showing no lights, with the inevitable whipping up of occasional stragglers from the convoy, some idea may be gathered of the arduous and unceasing work accomplished by the anti-submarine escorts.

It had been my practice during 1917 to call for returns from all commands of the number of hours that vessels of the destroyer and light cruiser type were actually under way per month, and these returns showed how heavy was the strain on the destroyers, particularly those engaged in convoy work.

For several months, for instance, the destroyers in the flotillas stationed at Devonport were under way on an average for just under 50 per cent. of the month.

This meant that several destroyers in these flotillas averaged quite 60 per cent. or even 70 per cent. of their time under way, as other vessels of the flotilla were laid up during the periods under review for longer refits due to

collision or other damage, in addition to the necessary four-monthly refit.

Anyone familiar with the delicate nature of the machinery of destroyers—which needs constant attention—and the conditions of life at sea in them will appreciate the significance of these figures and the strain which the conditions imposed on those on board as well as on the machinery.

It was evident in November, 1917, that the personnel and the machinery, whilst standing the strain in a wonderful manner, were approaching the limit of endurance, and anxiety was felt as to the situation during the winter.

Reports came in from the Grand Fleet indicating that the work of the destroyers engaged in protecting the ships of the Scandinavian convoy was telling heavily on the personnel, particularly on the commanding officers, and one report stated that the convoy work produced far greater strain than any other duty carried out by destroyers. No mean proportion of the officers were suffering from a breakdown in health, and since the *whole* of the work of the Devonport, Queenstown and North of Ireland flotillas consisted of convoy duty, whilst only a portion of the Grand Fleet destroyers was engaged in this work, the opinions expressed were very disquieting in their relation to the work of the southern flotillas.

However, the destroyers held on here as elsewhere, but it is only just to the splendid endurance of the young officers and the men who manned them to emphasize as strongly as I can the magnificent work they carried out in the face of every difficulty, and without even the incentive of the prospect of a fight with a foe that could be seen, this being the compensation given in their work to the gallant personnel of the Dover, Harwich and Grand Fleet flotillas. The convoy flotillas knew that their only

chance of action was with a submarine submerged, a form of warfare in which the result was so very frequently unknown and therefore unsatisfactory.

Under the new conditions the Admiralty took upon itself responsibility for the control of the ships of the Mercantile Marine in addition to its control of the movements of the Fleet. Indeed the control of convoys was even more directly under the Admiralty than was the control of the Fleet. In the latter case the proper system is for the Admiralty to indicate to the Commander-in-Chief, Grand Fleet, or to other Commands the objective, and to supply all the information possible regarding the strength of the enemy, his intentions and movements and such other information as can be of use to the Commander-in-Chief, but to leave the handling of the force to the Commander-in-Chief concerned. This is the course which was usually followed during the late war. It was my invariable practice when at the Admiralty.

In the case of convoys, however, a different system was necessary owing to the difficulty of transmitting information, the great delay that would be caused were this attempted, and the impossibility of control being exercised over all convoys at sea except by the Admiralty. Consequently the actual movements of convoys for the greater part of their passage were directed by the Naval Staff. Owing to ships not showing lights at night, convoys were diverted clear of one another by wireless signal if they were getting into dangerous proximity; they were directed to alter course as necessary to avoid areas in which submarines had been located, and occasionally it became necessary to alter the destination of some ships as they approached home waters. The movements of all convoys were "plotted" from day to day, indeed from

hour to hour, on a large-scale chart at the Admiralty, and it was easy to see at a glance the position of all the ships at any given time.

As the convoy approached home waters the ships came within the areas of the Commanders-in-Chief, Coast of Ireland, Devonport, and Portsmouth, and the Vice-Admiral Commanding the Dover Patrol, and were taken in charge by one or other of them. At each port a staff existed which kept a constant record of the movements of ships passing through or working in the Command, and enabled the Commander-in-Chief to take instant action if occasion arose.

The success of the convoy system in protecting trade is best shown by the figures relating to the year 1917 on the succeeding page (p. 144). In considering these figures the loose station-keeping of the ships in the Scandinavian convoy must be borne in mind. A large proportion of the ships in this convoy were neutrals, and it was naturally not possible to bring these vessels under discipline as was the case with convoys composed of purely British ships. Consequently there was much straggling, and the losses were proportionately heavier than in most of the Atlantic convoys. The comparatively heavy losses in the Gibraltar convoys were probably due to these convoys traversing two dangerous submarine zones. The extraordinary immunity of the French coal trade convoy from serious losses is remarkable and is probably due to the short passage which enabled most of the distance to be traversed at night and to the ships being of light draught.

The table on the following page would not be complete were no reference made to the heavy losses which were experienced during the year amongst ships which were *unescorted* through the danger zones, owing to the fact that no escorting vessels were available for the work.

LOSSES IN HOMEWARD BOUND CONVOYS, 1917.
PORTS OF DEPARTURE OF CONVOYS.

<i>Particulars of Convoys.</i>	NEW YORK AND HAMPTON ROADS. <i>Started in May.</i>			GIBRALTAR. <i>Started in July.</i>			SCANDINAVIAN. <i>Started in April.</i>			FRENCH COAL TRADE		
	<i>To end of Aug.</i>	<i>To end of Oct.</i>	<i>To end of Nov.</i>	<i>To end of Aug.</i>	<i>To end of Oct.</i>	<i>To end of Nov.</i>	<i>To end of Aug.</i>	<i>To end of Oct.</i>	<i>To end of Nov.</i>	<i>To end of Aug.</i>	<i>To end of Oct.</i>	<i>To end of Nov.</i>
No. of Ships conveyed . .	447	1,000	1,280	122	359	484	3,372	4,800	5,560	8,871	12,446	14,416
No. lost in convoys . .	5	11	11	2	8	12	42	6	3.63	16	20	24
Percentage of losses . .	1	1	.93	1.6	2.2	2.5	1.2	1.3	1.1	.18	.16	.16

In the Dakar convoy at the end of November and in the Halifax convoy 150 ships had been brought home without loss, whilst in the Sierra Leone convoy 1 ship had been lost out of 90 conveyed.

LOSSES IN OUTWARD BOUND CONVOYS STARTED IN AUGUST.
PORTS OF COLLECTION OF CONVOYS.

<i>Particulars of Convoys.</i>	MILFORD HAVEN.			LAMTASH.			PLYMOUTH.			FALMOUTH.		
	<i>To end of Aug.</i>	<i>To end of Oct.</i>	<i>To end of Nov.</i>	<i>To end of Aug.</i>	<i>To end of Oct.</i>	<i>To end of Nov.</i>	<i>To end of Aug.</i>	<i>To end of Oct.</i>	<i>To end of Nov.</i>	<i>To end of Aug.</i>	<i>To end of Oct.</i>	<i>To end of Nov.</i>
No. of Ships conveyed . .	86	360	535	35	175	284	42	246	.414	14	146	185
No. lost in convoys . .	Nil.	Nil.	3	1	2	2	Nil.	Nil.	1	Nil.	Nil.	Nil.
Percentage of losses . .	Nil.	Nil.	.56	2.8	1.1	.7	Nil.	Nil.	.23	Nil.	Nil.	Nil.

In the convoys starting from Queenstown 180 ships had been sent out to the end of November without loss.

There were naturally loud complaints of these losses, but these were inevitable in the absence of escorting vessels, and no one realized the dangers run more than those responsible for finding protection; every available vessel was not only working at highest possible pressure, but, as has been mentioned, breakdowns from overwork amongst escorting craft were causing very considerable anxiety.

The following figures show the dangers which were run by unescorted vessels :

<i>Period.</i>	<i>Losses amongst British merchant steamships in 1917 by submarine attack, under separate escort, under convoy or unescorted.</i>		
	<i>Ships under separate escort.</i>	<i>Ships under convoy.</i>	<i>Ships unescorted.</i>
Quarter ending June 30 ...	17	26	158
Quarter ending September 30 ...	14	29	148
October and November ...	12	23	90

In considering the above table it should be pointed out that a large proportion of the losses shown under the heading "Ships unescorted" took place amongst ships which had either dispersed from a convoy or which were on their way to join up with a convoy at the port of assembly. It was unfortunately quite impossible to provide escorts for all ships either to their ports of discharge or from their loading ports to the ports of assembly for the convoy, as we had so few vessels available for this work. Thus, in the month of November, 1917, out of 13 vessels engaged in the main oversea trade that were lost, 6 were in convoy, 5 had left or had not joined their convoy, and 2 were not joining a convoy and were unescorted.

November was the month of smallest British losses during the period of unrestricted warfare in 1917, and it

is of interest to examine the losses for that month. The total number of ships lost was 51. As many as 1,197 vessels entered or left home waters in *overseas trade* exclusive of the Mediterranean trade. Of this aggregate 87.5 per cent. were in convoy, and the total number of these vessels sunk (18) was divided amongst the following trades: North America, 1; Gibraltar, 5; West Africa and South America, 1; the Bay of Biscay, Portugal and Spanish ports west of Gibraltar, 5; Scandinavian, 1. In the same month there were 2,159 *cross-Channel sailings* and ten losses, nine of these vessels being unescorted.

Particulars of the locality of the total British losses of 51 ships for the month of November are as follows:

East Coast north of St. Abb's	...	...	...	1
East Coast between St. Abb's and Yarmouth	...	...	...	4
East Coast, Yarmouth to the Downs	...	...	...	4*
English Channel	...	...	...	21†
Bristol Channel	...	...	...	4
Irish Sea	...	...	...	2
Bay of Biscay	...	...	...	2
South of Cape St. Vincent	...	...	...	1
Mediterranean	...	...	...	11
East of Suez	...	...	...	1‡

* 2 by mine.

† 7 by mine.

‡ By mine.

In order to give some idea of the great volume of traffic on the East Coast and the consequent difficulty of affording proper protection, it may be mentioned that in the month of October, 1917, the number of vessels passing between Spurn Head (River Humber) and St. Abb's Head (to the northward) was 740 going north and 920 going south. Of this total only 228 of the

northward- and 413 of the southward-bound vessels were in convoy or under escort, the total losses being eleven, all amongst the unaccompanied ships.

Mention should be made here of the very serious situation which arose during the year 1917 owing to the success attending the attacks by enemy submarines on oil tankers bringing oil fuel to the United Kingdom for the use of the Fleet. A great many of these tank vessels were of great length and slow speed and presented the easiest of targets to the torpedo attack of a submerged submarine. So many vessels were sunk that our reserve of oil fuel became perilously low. Instead of a reserve of some five or six months we were gradually reduced to one of about eight weeks, and in order to economize expenditure of fuel it actually became necessary at one time to issue directions that the speed of oil-burning warships was to be limited except in cases of the greatest urgency. Such an order in war was a matter of much gravity; the great majority of our light cruisers and destroyers were fitted to burn oil fuel only, as well as our latest and most powerful battleships. The crisis was eventually overcome by drawing upon every source (including the Grand Fleet) for destroyers to escort the tankers through the submarine danger areas, and by the assistance given us by the Ministry of Shipping in bringing supplies of oil fuel to this country in the double bottoms of merchant ships. By the end of 1917 the situation had greatly improved.

The losses of shipping during 1917 were particularly heavy in the Mediterranean. Apart from the fact that the narrow waters of that sea render difficult a policy of evasion on the part of merchant shipping and give great advantages to the submarine, it was thought that the heavy losses in the early part of the year were

partly due to the method of routing the ships then in force, and in reply to representations made to the French Admiralty this system was altered by the French Commander-in-Chief. It should be noted that the Mediterranean outside the Adriatic was under French naval control in accordance with the agreement entered into with France and Italy. The cordial co-operation of the French Admiralty with us, and the manner in which our proposals were met, form very pleasant memories of my term of office at the Admiralty. During the greater part of the year 1917 Admiral Lacaze was Minister of Marine, whilst Admiral de Bon held office as Chief of the Naval Staff during the whole year. Nothing could exceed the courtesy extended to me by these distinguished officers, for whom I conceived great admiration and respect.

The result of the altered arrangement was a decided but temporary improvement, and the losses again became serious during the summer months. I then deemed it desirable that the control of the traffic should be placed in the hands of officers stationed at Malta, this being a central position from which any necessary change in the arrangements could be made more rapidly and with greater facility than by the French Commander-in-Chief, who was also controlling fleet movements and who, for this reason alone, was not in a position to act quickly.

A unified command in the Mediterranean would undoubtedly have been the most satisfactory and efficient system to adopt, but the time was not ripe for proposing that solution in 1917, and the alternative was adopted of British control of the traffic routes throughout the whole Mediterranean Sea subject to the general charge of the French Commander-in-Chief which was necessary in such an eventuality arising as an attempted "break out" of the Austrian Fleet.

Accordingly, with the consent of the French and Italian Admiralties, Vice-Admiral the Hon. Sir Somerset Gough-Calthorpe, K.C.B., was dispatched to the Mediterranean as British Commander-in-Chief; he was in control generally of all British Naval forces in the Mediterranean, and especially in charge of all the arrangements for the protection of trade and for anti-submarine operations, the patrol vessels of all the nationalities concerned being placed under his immediate orders for the purpose, whilst the whole of the Mediterranean remained under the general control of Vice-Admiral Gauchet, the French Commander-in-Chief. Admiral Calthorpe was assisted by French and Italian officers, and the Japanese Government, which had previously dispatched twelve destroyers to the Mediterranean to assist in the protection of trade, also gave to Admiral Calthorpe the control of these vessels.

In the requests which we addressed to the Japanese Admiralty I always received great assistance from Admiral Funakoshi, the Naval Attaché in London. His co-operation was of a close and most cordial nature.

The services of the Japanese destroyers in the Mediterranean were of considerable value to the Allied cause. A striking instance of the seamanlike and gallant conduct of their officers and men was furnished on the occasion of the torpedoing of a British transport by an enemy submarine off the coast of Italy, when by the work of the Japanese escorting destroyers the great majority of those on board were saved.

Admiral Calthorpe on leaving England was charged with the duty of organizing convoys in the Mediterranean on the lines of those already in force in other waters as soon as the necessary vessels were available, and a conference of Allied officers sat at Malta soon after his arrival, when a definite scheme of convoy was prepared. There

had always, however, been a great scarcity of fast patrol vessels in the Mediterranean for this work. Divided control of the forces in that area was partly responsible for this. The Austrian destroyers were considered by the Italian Admiralty to be so serious a menace in the Adriatic as to render it necessary to keep in that sea the great majority of the Italian destroyers as well as several French vessels of this class. The situation at the eastern end of the Mediterranean necessitated a force of some eight British destroyers being kept in the *Ægean* Sea to deal with any Turkish vessels that might attempt to force the blockade of the Dardanelles, whilst operations on the Syrian coast engaged the services of some French and British destroyers. Continual troop movements in the Mediterranean also absorbed the services of a considerable number of vessels of this type.

Consequently there was a great shortage of fast small craft for escort and mercantile convoy work. It was estimated that the escort force required for the protection of a complete system of convoy in the Mediterranean was approximately 290 vessels, the total number available being about 215.

In spite, then, of the success of Admiral Calthorpe's work, the result was that convoys were not started in the Mediterranean until October, and they were then but inadequately protected, and losses were heavy, both from this cause and from the fact already mentioned—that the Mediterranean is a sea which, by reason of its confined nature, is particularly suited for operations by submarines against trade. Its narrowness at various points, such as the Straits of Gibraltar, the Malta Channel, the Straits of Messina, and the passages to the *Ægean* cause such convergence of trade as to make it a very simple matter for a submarine to operate with success. Evasion by

change of route is almost impossible. Operations designed to prevent the exit of submarines from the Adriatic were difficult, because the depth of water in the Straits of Otranto militated against the adoption of effective mining and the laying of an effective net barrage.

For the above reasons the Admiralty was always very averse to the sending of a large volume of our Far Eastern trade through the Mediterranean, and strongly urged the Cape route instead; but the shortage of shipping, combined with the increased length of the Cape route, influenced the Ministry of Shipping to press strongly for the Mediterranean as opposed to the other route. A "through" convoy from England to Port Said was started in October, and by the end of November two ships had been sunk out of the thirty-five that had been under convoy. The return convoy, Port Said to England, was only started in December.

The losses of British merchant steamships per quarter in the Mediterranean during 1917 is shown below :

Quarter ending June 30	...	...	...	69
" " September 30	...	...	...	29
October and November	...	...	...	28

It is impossible to close this chapter describing the convoys without mention being made of the fine work accomplished by those upon whose shoulders fell the task of organizing and working the whole system. I cannot hope that I have succeeded in conveying to readers of this volume an adequate conception of the great and marvellously successful performance that it was or a full appreciation of what immense difficulties the staff had to contend with. They were very completely realized by

inc, who saw them appear day by day and disappear under treatment.

The head of the organization was, of course, Rear-Admiral A. L. Duff, the member of the Board and Staff immediately responsible also for the whole anti-submarine organization. Only those who witnessed Admiral Duff's work at the Admiralty during 1917 can realize the immense debt that the country owes to his untiring ability, patience, energy and resource. Capt. R. G. Henderson, who had been associated with the convoy system from its start, was an invaluable assistant, as also was Commander I. W. Carrington. Capt. Richard Webb, the Director of the Trade Division, and Capt. Frederic A. Whitehead, the Director of the Mercantile Movements Division, took an important share in the work of organization, whilst the work of Convoy Manager was carried through with quite exceptional skill by Paymaster-Commander H. W. F. Manisty. These officers were assisted by most capable staffs, and the Ministry of Shipping, without whose assistance the work could not possibly have been successfully carried out, co-operated most cordially.

CHAPTER VI

THE ENTRY OF THE UNITED STATES ; OUR NAVAL POLICY EXPLAINED

THE entry of the United States of America into the war in April, 1917, had an important although not an immediate effect upon our Naval policy. That the effect was *not immediate was due to the fact that the United States Navy was at the time indifferently provided with the particular classes of vessels which were so greatly needed for submarine warfare, viz. destroyers and other small surface craft, submarines and light cruisers ; further, the United States mercantile fleet did not include any considerable number of small craft which could be usefully employed for patrol and escort duty. The armed forces of the United States of America were also poorly equipped with aircraft, and had none available for Naval work. According to our knowledge at the time the United States Navy, in April, 1917, possessed twenty-three large and about twenty-four small destroyers, some of which were unfit to cross the Atlantic ; there were about twelve submarines capable of working overseas, but not well suited for anti-submarine work, and only three light cruisers of the " Chester " class. On the other hand about seven armoured cruisers were available in Atlantic waters for convoy duties, and the Navy included a fine force of battleships, of which fourteen were in full commission in April.*

At first, therefore, it was clear that the assistance which could be given to the Allied Navies would be but

slight even if all available destroyers were sent to European waters. This was, presumably, well known to the members of the German Naval Staff, and possibly explains their view that the entry of the United States of America would be of little help to the Allied cause. The Germans did not, however, make sufficient allowance for the productive power of the United States, and perhaps also it was thought in Germany that public opinion in the United States would not allow the Navy Department to send over to European waters such destroyers and other vessels of value in anti-submarine warfare as were available at once or would be available as time progressed. The German Staff may have had in mind the situation during the Spanish-American War when the fact of Admiral Cervera's weak and inefficient squadron being at large was sufficient to affect adversely the naval strategy of the United States to a considerable extent and to paralyze the work of the United States Navy in an offensive direction.

Very fortunately for the Allied cause a most distinguished officer of the United States Navy, Vice-Admiral W. S. Sims, came to this country to report on the situation and to command such forces as were sent to European waters. Admiral Sims, in his earlier career before reaching the flag list, was a gunnery officer of the very first rank. He had assimilated the ideas of Sir Percy Scott of our own Navy, who had revolutionized British naval gunnery, and he had succeeded, in his position as Inspector of Target Practice in the United States Navy, in producing a very marked increase in gunnery efficiency. Later when in command, first of a battleship, then of the destroyer flotillas, and finally as head of the United States Naval War College, his close study of naval strategy and tactics had peculiarly fitted him for the important post for which he was selected, and

he not only held the soundest views on such subjects himself, but was able, by dint of the tact and persuasive eloquence that had carried him successfully through his gunnery difficulties, to impress his views on others.

Admiral Sims, from the first moment of his arrival in this country, was in the closest touch with the Admiralty in general and with myself in particular. His earliest question to me was as to the direction in which the United States Navy could afford assistance to the Allied cause. My reply was that the first essential was the dispatch to European waters of every available destroyer, trawler, yacht, tug and other small craft of sufficient speed to deal with submarines, other vessels of these classes following as fast as they could be produced; further that submarines and light cruisers would also be of great value as they became available. Admiral Sims responded wholeheartedly to my requests. He urged the Navy Department with all his force to send these vessels and send them quickly. He frequently telegraphed to the United States figures showing the tonnage of merchant ships being sunk week by week in order to impress on the Navy Department and Government the great urgency of the situation. I furnished him with figures which even we ourselves were not publishing, as I felt that nothing but the knowledge given by these figures could impress those who were removed by 8,000 miles of sea from the scene of a Naval war unique in many of its features.

Meanwhile the British Naval Commander-in-Chief in North American waters, Vice-Admiral Sir Montague Browning, had been directed to confer with the United States Navy Department and to point out our immediate requirements and explain the general situation.

On April 6 the United States declared war on Germany. On April 18 we received information from Wash-

ington that the Navy Department was arranging to co-operate with our forces for the protection of trade in the West Atlantic should any enemy raiders escape from the North Sea, that six United States destroyers would be sent to European waters in the immediate future, and that the United States would undertake the protection of trade on the west coast of Canada and North America as well as in the Gulf of Mexico. It was further indicated that the number of United States destroyers for European waters would be increased at an early date. The vital importance of this latter step was being constantly urged by Admiral Sims.

When Mr. Balfour's mission left for the United States in April, Rear-Admiral Sir Dudley de Chair, the naval representative on the mission, was requested to do all in his power to impress on the United States Navy Department the very urgent necessity that existed for the immediate provision of small craft for anti-submarine operations in European waters and for the protection of trade.

He was informed that the position could not be considered satisfactory until the number of trawlers and sloops available for patrol and escort duty was greatly increased and that a total of at least *another hundred destroyers was required*.

It was pointed out that difficulty might arise from the natural desire of the United States Government to retain large numbers of small craft for the protection of shipping in the vicinity of the United States coast, but it was at the same time indicated that our experience showed that the number of submarines that the Germans could maintain on the western side of the Atlantic was very small, and that the real danger therefore existed in European waters.

Admiral de Chair was asked amongst other matters to emphasize the assistance which United States submarines could render on the eastern side of the Atlantic, where they would be able to undertake anti-submarine operations, and he was also directed to endeavour to obtain assistance in the production of mines, and the provision of ships for minelaying work. Great stress was, of course, laid upon the very important question of a large output of merchant ships and the necessity for repairing and putting into service the German merchant ships interned in U.S. ports was urged; directions were also given to Admiral de Chair to ascertain from Mr. Schwab, of the Bethlehem Steel Company, and other firms, to what extent they could build for the British Navy destroyers, sloops, trawlers and submarines, and the rapidity of such production.

The need for sloops was so great that I sent a personal telegram to Mr. Schwab, whose acquaintance I had made in October, 1914, on the occasion of the loss of the *Audacious*, begging him to build at once a hundred of these vessels to our order. I felt certain from the experience we had gained of Mr. Schwab's wonderful energy and power, as illustrated by the work accomplished by him in providing us in 1915 with ten submarines built in the extraordinarily short period of five months, that he would produce sloops at a very rapid rate and that there would be no delay in starting if he undertook the work. The drawings had already been sent over. However he was not able to undertake the work as the U.S. Government decided that his yards would all be required for their own work. This was unfortunate, as I had hoped that these vessels would have been built in from four to six months, seeing that the drawings were actually ready; they would have been invaluable in the latter part of 1917.

Whilst the mission was in the United States constant communications passed on these subjects, the heavy losses taking place in merchant ships were stated, and every effort was made to impress upon the Navy Department the urgency of the situation.

The tenor of our communications will be gathered from these quotations from a personal telegram sent by me to Admiral de Chair on April 26, viz. :

“For Rear-Admiral de Chair from First Sea Lord.

“You must emphasize most strongly to the United States authorities the very serious nature of the shipping position. We lost 55 British ships last week approximately 180,000 tons and rate of loss is not diminishing.

* * * * *

“Press most strongly that the number of destroyers sent to Ireland should be increased to twenty-four at once if this number is available.

“Battleships are not required but concentration on the vital question of defeat of submarine menace is essential.

“Urge on the authorities that everything should give way to the submarine menace and that by far the most important place on which to concentrate patrols is the S.W. of Ireland.

* * * * *

“You must keep constantly before the U.S. authorities the great gravity of the situation and the need that exists for immediate action.

“Our new methods will not be effective until July and the critical period is April to July.”

It was very necessary to bring home to the United States Navy Department the need for early action. Admiral Sims informed me—as soon as he became aware of the heavy losses to merchant shipping that were taking place—that neither he nor anyone else in the United States had realized that the situation was so serious. This was, of course, largely due to the necessity which we were under

of not publishing facts which would encourage the enemy or unduly depress our own people. Further, he informed me that an idea was prevalent in the United States that the *moral* of the German submarine crews had been completely broken by their losses in submarines. This impression was the successful result of certain action on our part taken with intent to discourage the enemy. Whatever may have been the case later in the year, we had, however, no evidence in the spring of 1917 of deterioration of *moral* amongst German submarine crews, nor was there any reason for such a result. It was therefore necessary to be quite frank with Admiral Sims; we knew quite well that we could not expect new measures to be effective for some few months, and we knew also that we could not afford a continuance of the heavy rate of loss experienced in April, without a serious effect being produced upon our war effort. We were certainly not in the state of panic which has been ascribed to us in certain quarters, but we did want those who were engaged in the war on the side of the Allies to understand the situation in order that they might realize the value that early naval assistance would bring to the Allied cause. There is no doubt that great difficulty must be experienced by those far removed from the theatre of war in understanding the conditions in the war zone. This was exemplified at a time when we had organized the trade in convoys and the system was showing itself effective in greatly reducing losses from submarine attack. We were pressing the United States to strengthen our escorting forces as far as possible in order to extend the convoy system, when a telegram arrived from Washington to the effect that it was considered that ships which were armed were safer when sailing singly than when in convoy. It has also been stated that the Admiralty held the view at this time that no solution of the problem created by

the enemy's submarine campaign was in sight. This is incorrect. We had confidence in the measures—most of them dependent on the manufacture of material—which were in course of preparation by the time the United States entered the war, but our opinion was that there was no *immediate* solution beyond the provision of additional vessels for the protection of shipping, and the reason for this view was that time was required before other measures could be put into effective operation; this is evident from the final paragraph of my telegram to Admiral de Chair, dated April 26, which I have quoted.

The first division of six United States destroyers, under the command of Lieut.-Commander T. K. Taussig, arrived in British waters on May 2, and they were most welcome. It was interesting to me personally that Lieut.-Commander Taussig should be in command, as he, when a sub-lieutenant, had been wounded on the same day as myself during the Boxer campaign in China, and we had been together for some time subsequently.

At about this time our advice was sought by the United States Navy Department as to the best type of anti-submarine craft for the United States to build; on this subject a very short experience in the war theatre caused Admiral Sims to hold precisely similar views to myself. As a result of the advice tendered a great building programme of destroyers, large submarine-hunting motor launches and other small craft was embarked upon. Although the completion of these vessels was delayed considerably beyond anticipated dates, they did, in 1918, exercise an influence on the submarine war.

The Germans made one great mistake, for which we were thankful. As already mentioned, it was anticipated that they would send submarines to work off the United States coast immediately after the declara-



Drifters at Sea.

tion of war by that country. Indeed we were expecting to hear of the presence of submarines in the West Atlantic throughout the whole of 1917. They did not appear there until May, 1918. The moral effect of such action in 1917 would have been very great and might possibly have led to the retention in the United States of some of the destroyers and other small craft which were of such assistance in European waters in starting the convoy system. Admiral Sims was himself, I think, anxious on this head. When the Germans did move in this direction in 1918 it was too late; it was by that time realized in the United States that the enemy could not maintain submarines in sufficient numbers in their waters to exercise any decisive effect, although the shipping losses might be considerable for a time, and consequently no large change of policy was made.

As is well known, Admiral Sims, with the consent of the United States Navy Department, placed all vessels which were dispatched to British waters under the British flag officers in whose Command they were working. This step, which at once produced unity of command, is typical of the manner in which the two navies, under the guidance of their senior officers, worked together throughout the war. The destroyers operating from Queenstown came under Admiral Sir Lewis Bayly; Captain Pringle, the senior United States officer on the spot, whose services were ever of the utmost value, was appointed as Chief of the Staff to Sir Lewis Bayly, whilst on the occasion of Sir Lewis Bayly, at my urgent suggestion, consenting to take a few days' leave in the summer of 1917, Admiral Sims, at our request, took his place at Queenstown, hoisting his flag in command of the British and United States naval forces. The relations between the officers and men of the two navies in this Command were

of the happiest possible nature, and form one of the pleasantest episodes of the co-operation between the two nations. The United States officers and men very quickly realized the strong personality of the Commander-in-Chief at Queenstown, and became imbued with the same feelings of great respect and admiration for him as were held by British officers and men. Also he made the officers feel that Admiralty House, Queenstown, was their home when in port, and saw that everything possible was done for the comfort of the men. The very high standard of duty set by Sir Lewis, and very fully sustained by him, was cheerfully and willingly followed by the United States force, the personnel of which earned his warmest admiration. I think it will be agreed in years to come that the comradeship between the two navies, first initiated in the Queenstown Command, went very far towards cementing the bonds of union between the two great English-speaking nations.

This was the first step in co-operation. The next was taken when the United States Navy Department, as the result of a request made by us to Admiral Sims, sent to Gibraltar a detachment of three light cruisers and a number of revenue cutters as patrol and escort vessels, placing the whole force under the British senior naval officer at Gibraltar, Rear-Admiral Heathcote Grant. Here again the relations between the two navies were of the happiest nature. Finally, later in the year, I discussed with Admiral Sims the desirability of a small force of United States battleships being sent to reinforce the Grand Fleet.

When the project was first mentioned my object in asking for the ships was that they might relieve some of our earlier "Dreadnoughts," which at that time it was desired to use for another purpose. I discussed the matter

also with Admiral Mayo, the Commander-in-Chief of the United States Atlantic Fleet, during his visit to this country in August, 1917, and with Admiral Benson, the Chief of Operations in the United States Navy Department, when he came over later in the year. Admiral Benson gave directions that four coal-burning battleships should be sent over. We were obliged to ask for coal-burning battleships instead of the more modern vessels with oil-fired boilers owing to the great shortage of oil fuel in this country and the danger of our reserves being still further depleted. These vessels, under Rear-Admiral Hugh Rodman, arrived in British waters early in December, 1917, and formed a division of the Grand Fleet. The co-operation afloat was now complete, and all that was needed was further co-operation between the British Admiralty and the United States Navy Department.

This had already formed the subject of discussions, first between Admiral Sims and myself, and later with Admirals Mayo and Benson.

During the summer of 1917 Admiral Sims had been invited to attend the daily meetings of the naval members of the operations side of the Board, an invitation which he accepted, and his co-operation was of great value; but we both felt it desirable to go a step farther, and I had suggested the extreme desirability of the United States Navy Department sending officers of experience of different ranks to work in the Admiralty, both on the operations and material side, officers upon whom the Navy Department could rely to place before us the views of the Department and to transmit their view of the situation as the result of their work and experience at the Admiralty. We had pressed strongly for the adoption of this course. Admiral Benson, after discussions, assented to it, and the officers on the material side com-

menenced work in the Admiralty towards the end of 1917, whilst those on the operations side joined the War Staff early in 1918.

It was felt that this course would complete the co-operation between the navies of the two countries and, further, that the United States Navy Department would be kept in the closest possible touch with the British Admiralty in all respects.

It is particularly to be remembered that even before we had established this close liaison the whole of the United States naval forces in British waters had been placed under the command of British naval officers. This step, so conducive to good results owing to the unity of command which was thus obtained, won our highest admiration, showing as it did a fine spirit of self-effacement on the part of the senior American naval officers.

The visits of Admirals Mayo and Benson to this country were productive of very good results. The exchange of information which took place was most beneficial, as was the experience which the admirals gained of modern naval warfare. Moreover, the utterly baseless suggestion which had, unfortunately, found expression in some organs of the Press of the United States that we were not giving the fullest information to the Navy Department was completely disproved.

When Admiral Mayo arrived in England he informed me that the main objects of his visit as Commander-in-Chief of the Atlantic Fleet were :

- (1) To ascertain our present policy and plans.
- (2) To inquire as to the changes, if any, that were contemplated in the immediate or more distant future.

(3) To ascertain what further assistance it was desired that the United States should provide from resources then available or likely to be soon available, and the measures that the United States should take to provide future forces and material.

Papers were prepared under my direction for Admiral Mayo giving full information of our immediate needs, of past procedure and of future plans. As to our needs, the main requests were :

(1) An increase in the number of destroyers, in order to enlarge the convoy system and to provide better protection for each convoy. An additional 55 destroyers were stated to be required for this service.

(2) An increase in the number of convoy cruisers for the same reason. The total addition of cruisers or old battleships was given as 41.

(3) An increase in the number of patrol craft, tugs, etc., for anti-submarine work.

(4) The rapid building of merchant ships.

(5) The supply of a large number of mines for the proposed barrage in the North Sea, and assistance towards laying them by the provision of United States minelaying vessels.

(6) Aircraft assistance in the shape of three large seaplane stations on the coast of Ireland, with some 86 machines at each station.

(7) The provision of four coal-burning battleships of the "Dreadnought" type to replace Grand Fleet "Dreadnought" battleships which it was desired to use for other purposes.

Admiral Mayo was informed that some 100,000 mines

would be required from the Americans for forming and maintaining that portion of the North Sea Barrage which it was suggested should be laid by them, in addition to the large number that it was proposed that we ourselves should lay in the barrage, and that as the barrage would need patrolling by a large number of small craft, great help would be afforded if the United States could provide some of these vessels. It was estimated at that time that the barrage would absorb the services of some 250 small vessels in order that a sufficient number might be kept constantly on patrol.

It may be of interest to give the history of the North Sea Barrage so far as I can recollect it. Our views on such a scheme were sought by the United States Navy Department in the spring of 1917. Owing to various military circumstances, even at that time we had no prospect of obtaining mines in adequate numbers for such work for at least nine to twelve months, nor could we provide the necessary craft to patrol the barrage. Our view was that such mines as became available during the last months of 1917 would be more effective if laid nearer to the German North Sea naval bases, and in the Straits of Dover, than at such a distance from these bases as the suggestion involved. Apart from our desire to stop the submarines near their bases, the pros and cons of the scheme were as follows :

The advantages were :

- (1) That, except for the difficulty of preventing the submarines from using Norwegian territorial waters for egress, a North Sea Barrage would be a menace to submarines using the Kattegat exit as well as those coming from North Sea bases.
- (2) That the enemy would be unable to sweep up

the minefield, owing to its distance (over 200 miles) from his bases.

The disadvantages were :

(1) The immense number of mines required—some 120,000, excluding reserves—and the improbability of producing them in Great Britain.

(2) The great depth of water in which many of them were to be moored, a depth in which no mines had ever been successfully laid before ; time would be required to devise arrangements that would enable the mines to be laid at such depths.

(3) The very large number of patrol craft that would be needed to force submarines to dive into that portion of the minefield which was safe for surface vessels and the difficulty of maintaining them at sea in bad North Sea weather.

(4) The difficulty of preventing egress by the submarines in Norwegian territorial waters, in which, even if mines were laid, they would have to be moored at such a depth as not to constitute a danger to vessels on the surface.

Shortly after the subject was broached to us we learned that the United States Navy had devised a mine that it was expected would be satisfactory for the purpose of the barrage. An experienced mining officer was at once sent over by us to inspect the mine and to give to the United States officers such assistance as was possible due to his great knowledge of mining under war conditions.

When he arrived in the United States the mine was still in the experimental stage, but later he reported that it promised to be successful, and in view of the great manufacturing resources in America, it appeared that a

considerable proportion of the mines for the barrage could be provided by the United States Navy. Our own efforts to produce a mine suitable for very great depths were also proving successful and anticipations as to manufacture were optimistic. Accordingly plans were prepared for a barrage across the North Sea, which were given to Admiral Mayo before he left England on his return to the United States. Without seriously relaxing our mining operations in the Heligoland Bight, and without interfering with our mine barrage on the Folkestone—Grisnez line, we anticipated at this time that we could provide mines for our portion of the North Sea Barrage by the time that the United States supply of mines was in readiness to be laid.

Admiral Mayo was also furnished with papers dealing at length with our naval policy at the time and the intended future policy, both in home waters and abroad. Papers were given him relating to our air policy, to the attitude of neutral countries, to the Belgian coast problem, to the blockade, to the defence of trade (including one on the convoy system), to such subjects as the defensive armament of merchant ships with guns, smoke apparatus and mine defence gear, the instruction of the personnel in their use, and the system of issuing route instruction to merchant ships. An important statement was also supplied giving a detailed account of our anti-submarine policy, both at the time and in the future.

These papers gave the fullest information on the naval problem, and were intended to put the United States Naval Department in a position to appreciate the whole position and its many embarrassments, though we realized that these could be appreciated only by those who, like Admiral Sims, were in daily contact with the problems. It will possibly be of further interest if

mention is made of some of the points to which attention was drawn.

Admiral Mayo, for instance, was informed that British naval policy was being directed in 1917, as during the remainder of the war, to exerting constant economic pressure upon the enemy with a view to forcing him to come to terms. We also endeavoured to prevent the enemy from interfering with the conduct of the war by ourselves and our Allies. In the effective pursuit of that policy the duty of the Navy involved :

(1) The protection of the sea communications of the Allied armies and the protection of British and Allied trade.

(2) The prevention of enemy trade in order to interfere with his military operations and to exert economic pressure.

(3) Resistance to invasion and raids.

It was pointed out that the question at issue in each case was the control of sea communications, and in order to attain that control permanently and completely the enemy's naval forces both above and below water had to be destroyed or effectually masked. As the weaker German Fleet not unnaturally refused decisive action and as its *destruction* had hitherto not been achieved, we had adopted a policy of guarding an area between our vital communications and the enemy's ports, and of guarding the areas through which the trade and transports passed ; these were the only methods of frustrating attacks made either by surface vessels or by submarines which succeeded in reaching open waters. It was pointed out that a combination of these two methods had been in force during the wars of the eighteenth century, blockades being combined with the convoy system and the patrol

of local areas by frigates, etc. History, in fact, was repeating itself.

We mentioned that a close blockade of the German North Sea and Baltic ports presented insuperable difficulties under the conditions of modern warfare, and the alternative of controlling the Dover and Norway—Scotland exits to the North Sea had been adopted. The former protected the communications of the armies in France, whilst the two combined covered the maritime communications of the world outside the North Sea and Baltic, and if they could be effectively guarded our first two objects would be attained.

So far as the Dover exit was concerned we stated that the narrowness of the waters, with the consequent risk to the enemy from our mines and torpedoes, had so far acted as a deterrent to his capital ships; we had to depend on the light forces at Harwich and Dover to deal with any enemy surface craft attacking the southern area from German ports.

We pointed out that the control of the Norway—Scotland exit depended upon the presence of the Grand Fleet at Rosyth or at Scapa. This fleet ensured the safety of all the vessels engaged in protecting trade and in hunting submarines outside the North Sea.

Mention was made of the fact that the enemy could not open the sea routes for his own war ships without risking a serious action, and that so far he had shown no inclination to run that risk. The Battle of Jutland having been fought in the previous year, any future movement of the High Sea Fleet into the North Sea would probably be merely with the object of drawing our capital ships into prepared areas so as to bring about a process of attrition by mines and torpedoes. Such a movement had been carried out on August 19, 1916. The reasons which had

led to the adoption of the Orkney—Faroe—Iceland blockade line were also explained.

It was pointed out that in the early stages of the war, the foregoing general dispositions had sufficed to protect the Allies' communications and to throttle those of the enemy outside the Baltic. Although enemy cruisers in foreign waters and a few raiding vessels which had evaded the blockade had inflicted losses on trade, losses from such causes could not reach really serious proportions so long as the enemy trusted to evasion and refused to face the Grand Fleet. The danger of serious loss from attack by raiding surface craft had also been greatly minimized by the adoption of the convoy system. But as the enemy's submarines increased in size, efficiency and numbers, the situation had been modified, for evasion by submarines of the command exercised by the Grand Fleet was easy, and our vital sea communications could be attacked by them without the risk of a fleet action.

So far as the protection of trade was concerned, the effect therefore of the submarine campaign had been to remove the barrier established by the Grand Fleet and to transfer operations to the focal areas and approach routes.

As the situation developed, a policy of dealing with the submarines by armed patrol craft and decoy ships in these areas had therefore been put into force. Merchant ships had been armed as rapidly as possible, and in addition efforts had been made to intercept the submarines *en route* to these areas both in the vicinity of German waters and farther afield.

The great area covered by the approach routes and the increasing radius of submarine operations had made the provision of a sufficient number of patrol vessels a practical impossibility and had led to a general adoption

of the convoy system as rapidly as the supply of fast small craft made this possible.

The methods of attacking German submarines before they could reach open waters, by extensive mining in the Heligoland Bight, with the exception of Dutch and Danish territorial waters, were also mentioned.

As regards *future* naval policy it was pointed out that the enemy submarine campaign was the dominating factor to such an extent that any sustained increase in the then rate of sinking merchant ships might eventually prove disastrous.

Mention was made of the fact that the enemy was still producing submarines faster than the Allies were destroying them; the policy of coping with submarines after they reached the open sea had not as yet been sufficiently effective to balance construction against losses, even in combination with the extensive minefields laid in the Heligoland Bight.

The future policy was therefore being directed towards an attempt at a still more concentrated and effective control in the areas between the enemy's ports and our trade routes, and it was proposed to form some description of block or barrage through which the enemy submarines would not be able to pass without considerable risk. Four forms had been considered :

(1) A method of blocking either mechanically or by mines all the exits of the submarines from their North Sea or Baltic bases.

(2) A barrage of mines at different depths, from near the surface of the sea to near the bottom.

(3) A combination of deep mines with a patrolling force of surface craft and aircraft whose object would

be to force the submarines under the surface into the minefield.

(4) A force of surface craft and aircraft patrolling an area of sufficient extent to prevent submarines coming to the surface to recharge their batteries during the hours of darkness.

Admiral Mayo was informed that in our opinion the first scheme as given above, viz. *that of absolutely sealing the exits, was the only radical cure for the evil*, but that there were very great difficulties to be overcome before such an operation could be successfully carried out. He was shown the plan that had been prepared for a mechanical block of all the enemy North Sea bases, and he entirely concurred in the impracticability of carrying it out. Such a plan had been advocated by some officers and by other people; it was, of course, most attractive in theory and appealed strongly to those who looked at the question superficially. When, however, a definite operation came to be worked out in detail the difficulties became very apparent, and even enthusiastic supporters of the *idea* were forced to change their views. It was not a matter for surprise to me that the idea of sealing the exits from submarine bases was urged by so many people on both sides of the Atlantic. It was, of course, the obvious counter to the submarine campaign, and it appealed with force to that considerable section which feels vaguely, and rightly, that *offensive* action is needed, without being quite so clear as to the means by which it is to be carried out.

In this particular case I informed the clever and able officers to whom the planning of the operation was entrusted that they were to proceed on the assumption that we intended to seal the enemy's ports somehow, and that they were to devise the best possible scheme, drawing up

all the necessary orders for the operations. This was done in the most complete detail and with great care and ingenuity, but at the end there was no difference of opinion whatever as to the inadvisability of proceeding with the operations.

It is to be observed in connexion with this question that scaling the North Sea bases would not have been a complete cure, since submarines could still make their exit via the Kattegat, where we could not block channels without violating the neutrality of other nations.

The final conclusion arrived at *was to use a combination of the last three alternatives* provided that a *satisfactory type of mine* could be produced in sufficient numbers and a sufficient supply of small craft provided by ourselves and the United States.

Full details were given to Admiral Mayo of the proposed North Sea Barrage on a line totalling 230 miles in length, which was divided into three parts, Areas A, B and C, of which Area A only would be dangerous to surface vessels.

It was estimated that Area A would require 36,300 mines, and it was proposed that this area should be mined by the United States forces with United States mines.

It was proposed that the British should mine Area B, the requirements being 67,500 mines, and that the United States should mine Area C, for which 18,000 United States mines would be required.

The reasons governing the selection of the mine barrage area were fully given, and the advantages arising from the use of the United States pattern of mine instead of the British mine for Areas A and C were stated.

Admiral Mayo was also informed of our intention to establish a mine barrage in the Channel, on the Folkestone—Grisnez line, as soon as mines were available,

with a strong force of patrol vessels stationed there, whose duty it would be to compel enemy submarines to dive into the minefield. He was further made acquainted with our intended policy of still closer minelaying in the Heligoland Bight.

Although Admiral Mayo was not actually informed of the details of the future policy which it was hoped to adopt in the Adriatic for the improvement of the Otranto Barrage, various schemes were at the time being worked out between the British, French and Italian Admiralties, having as their object the prevention or obstruction of the exit of enemy submarines from the Adriatic, in the same way as it was hoped to obstruct German submarines from making their exit from the North Sea without incurring heavy losses. The great depth of water in the southern part of the Adriatic constituted the main difficulty facing us in the solution of this problem. In August, 1917, it was, however, definitely decided to establish a barrage of nets and mines across the Straits of Otranto, and the work was put in hand. This became effective during 1918.

The paper on Naval Air Policy showed the aim of the Admiralty to be :

To provide in sufficient numbers a type of airship which would be able to scout with the Grand Fleet, and, in this respect, to perform the duty of light cruisers. Airship stations had been established on the East Coast for this purpose.

To provide also a type of airship for coastal patrol work and for the escort of merchant ships in convoy. For these airships stations had been established on the East, South and West Coasts and at Scapa.

To provide a sufficient supply of kite balloons for the

work of the Grand Fleet. Fleet kite balloon stations had already been established at Rosyth and Scapa, and the resources of the latter station were supplemented by a kite balloon ship. It was intended also to provide kite balloons for flotillas or single vessels engaged in submarine hunting or in convoy work. A large number of kite balloon stations for anti-submarine work had been or were being established round the coast for this work.

As to the future programme of rigid airships, Admiral Mayo was told that it was under consideration to construct three new rigid stations, also that three new stations for the use of non-rigids for anti-submarine work were to be established, while it was also proposed to provide sufficient resources to allow of a number of kite balloons being worked in vessels between the North of Scotland and Norway and to the eastward of the English Channel.

Admiral Mayo was also informed that it was proposed to provide sufficient "heavier than air" craft of various types for the Fleet, both to insure adequate air reconnaissance and to drive off hostile aircraft. The Grand Fleet was at the time already provided with three seaplane carriers, and the *Furious* and other special vessels were being fitted to carry aircraft. Many of the armoured vessels and light cruisers of the Fleet had also been fitted to carry aircraft, whilst the Harwich light cruiser force possessed one seaplane carrier; two carriers were devoted to anti-submarine work, and three were employed in the Mediterranean.

It was further stated that machines for naval reconnaissance were working from several East Coast stations, and that lighters to carry seaplanes for more extended reconnaissance and offensive work were under construction. The work carried out by our naval aircraft

off the Belgian coast, comprising the duty of keeping the coast under constant observation, of spotting the gunfire of ships, of fighting aircraft and bombing objectives of importance, were also mentioned, as well as the work in the Mediterranean, where there were four bases in the *Ægean*.

The extensive anti-submarine patrol work round the British Isles and in the Mediterranean was touched upon, there being " heavier than air " stations at the time at

Houton Bay.	Westgate.
Dundee.	Dover.
South Shields.	Newhaven.
Bembridge.	Cherbourg.
Culshot.	Plymouth.
Portland.	Newlyn.
Killingholme.	Scilly.
Yarmouth.	Fishguard.
Felixstowe.	

Steps were being taken to extend the number of stations as soon as possible, the new programme including stations at such places as

Padstow.	Loch Ryan (or in the
Wexford.	Hebrides).
Queenstown.	Shetlands.
Berehaven.	Peterhead.
Loch Foyle.	

In the event of the United States being in a position to co-operate in the work, it was recommended that the three main seaplane stations in Ireland should be taken over by the Americans, and equipped, manned and controlled entirely by United States personnel.

In regard to the convoy system a full description of the whole organization was given, with the results up to date, and details of the vessels available and still needed for its protection.

Full information was afforded on the subject of the arming of merchant ships and fitting other defensive measures to them, and the routeing system in use for merchant ships was described in detail.

In the remarks on our anti-submarine warfare it was pointed out that anti-submarine measures were carried out both on the surface, under water, and in the air.

The surface measures were described as follows :

In twelve of the twenty-two areas into which the waters round the United Kingdom were divided, regular *hunting flotillas* were at work, comprising trawlers and motor launches fitted with hydrophones. Before the institution of the convoy system a few fast vessels, such as destroyers or "P" boats, had been formed into hunting flotillas, but the convoy work had necessitated the withdrawal of all these vessels, and the work of the flotillas had suffered in consequence, the speed of trawlers being too slow to offer the same prospect of success in such anti-submarine measures. The flotillas of motor launches which had been formed were of considerable utility in fine weather, but they could only operate in comparatively smooth water.

At the time of Admiral Mayo's visit a force of thirty-two trawlers to work with about six sloops or destroyers was being organized as vessels became available, to operate in the North Sea with a view to engaging enemy submarines on passage in those waters.

It was also pointed out to Admiral Mayo that the coast patrol vessels which were not actually in the hunting flotillas were all engaged in anti-submarine work and

did frequently come into action against the German submarines.

Finally Admiral Mayo was informed that the convoy system itself was looked upon as an offensive measure since the German submarines would, in order to attack vessels under convoy, be forced into contact with the fast craft engaged in the work of escort and thus place themselves in positions in which they could themselves be successfully attacked.

Admiral Mayo, during his stay in European waters, inspected some of our naval bases and paid a visit to the Grand Fleet.

He crossed to France in order that he might see the work being carried out at French ports by vessels of the United States Navy, and while returning from this visit he honoured the British Navy by accompanying Sir Reginald Bacon and myself in *H.M.S. Broke* to witness a bombardment of Ostend by the monitor *Terror*. On this occasion Admiral Mayo's flag was hoisted in the *Broke* and subsequently presented to him as a souvenir of the first occasion of a United States Admiral having been under fire in a British man-of-war. It is satisfactory to record that subsequent aerial photographs showed that much damage to workshops, etc., had been caused by this bombardment.

The Admiral and his Staff very quickly established themselves in the high regard of British naval officers, and it was with much regret that we witnessed their return to the United States. My own associations with the Admiral had led to a feeling of great friendship. He left behind him his Chief of Staff, Captain Jackson, who to our great regret had been seriously injured in a motor accident.

Admiral Benson's visit took place later in the year.

I had written to him urging him to come across so that he might have first-hand knowledge of the state of affairs and of the policy being followed. During his visit the same questions were discussed as with Admiral Mayo, and important action was taken in the direction of closer naval co-operation between the Allies by the formation of an Allied Naval Council consisting of the Ministers of Marine and the Chiefs of the Naval Staff of the Allied Nations and of the United States. This proposal had been under discussion for some little time, and, indeed, naval *conferences* had been held on previous occasions. The first of these during my tenure of office at the Admiralty was on January 28 and 24, 1917, and another was held during the visit of Admiral Mayo and at the instigation of the Government of the United States on September 4 and 5, 1917. On this latter occasion important discussions had taken place, principally on the subject of submarine warfare, the methods of dealing with it in home waters and in the Mediterranean, and such matters as the provision of mercantile shipping for the use of our Allies.

There was, however, no regular council sitting at specified intervals, and it was this council which came into being in the early part of December. Its functions were to watch over the general conduct of the naval war and to insure co-ordination of the effort at sea as well as the development of all scientific operations connected with the conduct of the war.

Special emphasis was laid upon the fact that the individual responsibility of the respective Chiefs of the Naval Staff and of the Commanders-in-Chief at sea towards their Governments as regards operations in hand as well as the strategical and technical disposition of the forces placed under their command remained unchanged ;

this proviso was a necessity in naval warfare, and was very strongly insisted upon by the Admiralty.

The attention of the Council was directed at the earliest meetings to the situation in the Mediterranean, where naval forces from the British Empire, France, Greece, Italy, Japan and the United States were working, and where the need for close co-operation was most urgent. The real need in the Mediterranean, as was frequently pointed out, was the inclusion of the naval forces of all the Allied nations under one single command. In 1918 strong efforts were made to carry out this policy, and indeed the actual Admiralissimo was selected, but the attempt failed in the end.

Both these distinguished American officers were reminded, as indeed they must have seen for themselves, that the successful combating of the submarine danger depended largely on the manufacture of material, and that the resources of this country, with its great fleet and its large and increasing armies, were so seriously taxed that the execution of the plans of the Admiralty were being constantly and gravely delayed. The Admiralty was, indeed, seriously embarrassed by difficulties in the adequate supply of mines and other means of destroying submarines as well as of fast craft of various descriptions. The Admiralty, as was pointed out, were doing not what they would like to do, but what they could do, both in the way of offensive and defensive action. The supplies of raw material and labour controlled in large measure the character and extent of the operations at sea.

CHAPTER VII

PATROL CRAFT AND MINESWEEPING SERVICES

It is difficult to give an idea of the truly magnificent work achieved by the patrol and minesweeping services during the year 1917 without showing how these services expanded after the outbreak of war in 1914.

When war was declared the only vessels immediately available for the work consisted of seven torpedo gunboats manned by officers and men of the Royal Navy, and fourteen trawlers manned by fishermen. All these vessels were fitted for regular minesweeping work, and the crews of the trawlers formed a part of what was known as the "Trawler Reserve." Other trawlers, exceeding eighty in number, became, however, almost immediately available at the outbreak of war under the organized Trawler Reserve which had been set up a year or two preceding the outbreak of war. Men belonging to this reserve had been trained in the work of minesweeping and were paid a small retaining fee.

As soon as the German methods of indiscriminate minelaying and submarine attacks upon merchant ships commenced, a great expansion of this force became necessary. The matter was handled energetically by the Admiralty at the time, and by the end of 1914 over 700 vessels (yachts, trawlers and drifters) were employed on patrol and minesweeping duties, and the Admiralty had also commenced to build vessels of the trawler type specially for this work.

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By the commencement of 1917 there were in use some 2,500 yachts, trawlers and drifters, the great majority of them manned by fishermen or men of the R.N.R. or R.N.V.R. and officered by trawler or drifter skippers or officers of the R.N.R. or R.N.V.R., many of them having temporary commissions in these services.

Early in the war the coast of the United Kingdom had been divided into areas for purposes of patrol and minesweeping, and each area was under the command of a naval officer on either the active or retired list.

The Chart D shows the respective areas at one period. No very important changes took place in the delimitation of the areas during the war, and the chart may therefore be considered generally representative of the organization. Chart E shows the zones into which the Mediterranean was divided.

In December, 1917, the number of vessels of different classes actually appropriated to various areas is given on the next page in Table A for the British Isles and Table B for the Mediterranean.

It will be seen that the total number of British patrol and minesweeping craft, exclusive of the stationary boom defence vessels, was at this time 3,084. Of this number 473 were in the Mediterranean, 824 were in the English Channel between The Nore and Falmouth, 557 were in Irish waters or on the west coast of England, and the remaining 1,230 were on the east coast of England and the east and west coasts of Scotland and the Orkneys and Shetlands.

The work of these vessels was almost entirely of an anti-submarine or minesweeping nature.

The trawlers were engaged in patrol duty, convoy escort service, and minesweeping. The drifters worked

The Crisis of the Naval War

TABLE A; AUXILIARY PATROLS IN HOME WATERS.

Area No.	Yachts.	Trawlers.	Whalers.	Motor Launches.	Net Drifters.	Other Drifters.	Motor Drifters.	Motor Boats.	Paddle or Screw Minesweepers.	Patrol Paddlers.	Boom Defence. Trawlers.	Boom Defence. Drifters, etc.
I	5	44	4	6	22	2	11	—	3	—	—	6
II	6	119	7	15	72	112	6	—	8	—	60	83
IV	1	27	—	12	10	3	—	—	—	—	15	10
V	1	26	—	8	12	1	7	—	—	—	—	—
VI	6	51	1	24	9	14	14	—	13	—	20	23
VIII	1	51	—	16	25	—	4	—	9	—	—	—
IX	1	93	3	6	25	1	4	—	8	—	7	25
X	2	16	—	6	27	—	—	2	—	—	—	—
—	—	53	—	6	—	19	—	—	—	—	—	—
—	—	30	—	6	28	—	2	—	7	—	—	5
—	1	29	—	33	42	—	—	—	9	—	3	13
XI	2	70	—	31	101	—	—	—	19	—	—	2
—	1	—	—	—	—	30	—	—	—	—	—	—
XII	2	35	—	26	22	10	—	—	6	—	—	10
—	—	18	—	5	18	—	—	—	—	—	—	—
—	—	14	—	2	25	2	—	—	—	—	—	—
—	—	6	—	—	—	—	—	—	—	—	—	—
—	—	—	—	4	31	—	—	1	—	—	—	—
XIII	1	27	—	19	15	—	—	—	5	—	—	—
XIII A	—	54	—	21	19	—	—	—	—	—	—	1
XIV	2	44	—	14	41	—	—	—	—	—	—	2
—	—	6	—	6	6	—	—	—	5	—	—	—
XV	3	46	—	8	59	2	—	—	—	—	3	—
XVI	3	19	—	12	13	—	—	—	—	—	—	1
—	—	9	—	6	16	—	5	—	5	—	—	—
XVII	3	26	—	12	68	1	—	—	4	—	—	1
—	1	10	—	6	31	—	—	—	—	—	4	2
XVIII	—	31	—	—	11	4	—	—	—	—	4	—
XIX	—	7	—	8	—	—	—	—	—	—	—	—
XX	—	8	—	6	4	—	—	—	—	—	—	1
XXI	1	15	—	16	11	—	6	—	7	—	2	3
XXII	1	10	—	6	14	—	—	—	—	—	—	—

TABLE B; AUXILIARY PATROLS IN THE MEDITERRANEAN ZONES.

I	7	9	—	19	—	—	—	—	—	—	—	—
VI	1	12	—	42	116	—	—	—	—	—	—	—
VIII	2	61	—	21	25	—	—	—	—	—	2	2
V	1	51	—	18	—	—	—	—	—	—	—	—
X	1	47	—	17	6	—	—	—	—	5	—	—
—	2	—	—	12	—	—	—	—	—	—	—	—
—	2	22	—	—	4	—	—	—	—	—	2	—
—	1	4	—	11	—	—	—	7	—	—	—	—

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drifting nets fitted with mines as an anti-submarine weapon, and also in the case of the Dover area they laid and kept efficient a barrage of mine nets off the Belgian coast. Some were also fitted with hydrophones and formed hunting flotillas, and some were engaged in minesweeping duties, or in patrolling swept channels. At Fleet bases a small number were required to attend on the ships of the Fleet, and to assist in the work of the base. The whalers, being faster vessels than the trawlers, were mostly engaged on escort duty or on patrol. The motor launches were employed for anti-submarine work, fitted with hydrophones, and worked in company with drifters and torpedo-boat destroyers, or in minesweeping in areas in which their light draught rendered it advantageous and safer to employ them instead of heavier draught vessels to locate minefields, and in the Dover area they were largely used to work smoke screens for operations on the Belgian coast.

As the convoy system became more general, so the work of the small craft in certain areas altered from patrol and escort work to convoy duty. These areas were those on the East Coast and north-west of Scotland through which the Scandinavian and East Coast trade passed, and those in the Channel frequented by the vessels employed in the French coal trade. The majority of these ships were of comparatively slow speed, and trawlers possessed sufficient speed to accompany them, but a few destroyers of the older type formed a part of the escorting force, both for the purpose of protection and also for offensive action against submarines attacking the convoys, the slow speed of trawlers handicapping them greatly in this respect.

The difficulty of dealing with submarines may be gauged by the enormous number of small craft thus

employed, but a consideration of the characteristics of a submarine and of the great volume of traffic passing up and down our coasts will assist in a realization of the varied and difficult problems set to the British Navy.

For instance, the total number of vessels passing Lowestoft during the month of April, 1917, was 1,837 British and Allied and 208 neutral, giving a *daily* average of 62 British and Allied and 7 neutral ships; and as Admiral Sir Reginald Bacon has mentioned in his book, "The Dover Patrol, 1915-17" (page 51), an average of between 80 to 100 merchant vessels passed Dover daily during 1917. A study of these figures gives some idea of the number of targets offered daily to ordinary submarines and minelaying submarines in two of the areas off our coasts. When it is borne in mind that the Germans had similar chances of inflicting heavy losses on our mercantile marine all round the coasts of the United Kingdom, and that it was obviously impossible to tell where an underwater attack would take place, it will be realized that once submarines reached our coasts, nothing short of an immense number of small craft could deal satisfactorily with the situation, and afford any degree of protection to trade. Minelaying by submarines was a particularly difficult problem with which to deal; the enemy frequently changed his methods, and such changes when discovered involved alterations in our own procedure. Thus for some time after the commencement of minelaying by submarines, the whole of the mines of one submarine would be laid in a comparatively small area. It was fairly easy to deal with this method as a dangerous area was proclaimed round the spot where a mine was discovered, and experience soon showed the necessary extent of area to proclaim. Later the submarines laid mines in groups of about six. This necessitated the proclamation

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of more than one area, and was naturally a more difficult problem. At a further stage the submarines scattered their mines in even smaller numbers, and the task of ensuring a safe channel was still further increased. The most difficult artifice to deal with, however, was the introduction by the Germans of a delay action device in their mines, which caused them to remain at the bottom for varying periods after being laid. The ordinary minesweep, the function of which was to catch the mooring rope of the mine and drag the mine clear of the channel, was, of course, ineffective against the mine on the bottom, and there was no guarantee that mines might not be released from the bottom and rise to a depth at which they were dangerous, *after the channel had been swept and reported clear*. To deal with this danger a chain-sweep to work on the bottom was introduced, but its use presented many difficulties, especially over a rocky bottom.

When a regular swept and buoyed channel was in use the enemy had little difficulty in deciding on the positions in which to lay mines by reason of the presence of the buoys. This fact constituted the principal disadvantage in the use of a buoyed channel, but in certain places where the traffic was heavy the procedure was inevitable, and it greatly simplified the work of the patrol craft and minesweepers; the only precautions possible lay in the use of alternative marked channels, and in the laying of defensive deep minefields outside the channel in which enemy submarines might compass their own destruction. As rapidly as our supply of mines admitted, this latter device was adopted in positions where the minefields could not constitute a danger to our own submarines. False buoyed channels with mined areas round them could also be laid in which to catch the submarine. Another device was that of altering the position of light vessels

and buoys with the object of putting a submarine on to a shoal.

The situation with which our patrol and mine-sweeping craft had to deal having now been stated, it remains to speak of the magnificent manner in which they accomplished their task.

I regret very deeply that, in spite of a strong desire to undertake the task, I have neither the information nor the literary ability to do justice to the many deeds of individual gallantry, self-sacrifice and resource performed by the splendid officers and men who manned the small craft. No words of mine can adequately convey the intense admiration which I felt, and which I know was shared by the whole Navy, for the manner in which their arduous and perilous work was carried out. These fine seamen, though quite strange to the hazardous work which they were called upon to undertake, quickly accustomed themselves to their new duties, and the nation should ever be full of gratitude that it bred such a race of hardy, skilful and courageous men as those who took so great a part in defeating the greatest menace with which the Empire has ever been faced.

There are, however, just two cases in 1917, typical of many others, which I cannot forbear from mentioning. The first occurred off the East Coast of England.

On August 15 the armed fishing craft *Nelson* and *Ethel and Millie* were attacked by gunfire by a German submarine on the surface at a range of four to five miles.

The submarine first concentrated her fire on the *Nelson*, which immediately slipped her trawl and went to action stations. The third shot from the submarine pierced the trawler's bows, and, having established the range, the submarine poured a well-directed fire into

the *Nelson*, under which she rapidly began to settle down.

The seventh shot struck the skipper, Thomas Crisp, D.S.C., R.N.R., taking off both his legs and partly disembowelling him.

In spite of the terrible nature of his injuries he retained consciousness and gave instructions to the mate, who was his son, to send a message by carrier pigeon to the senior officer of his base reporting that he was engaged with the enemy; he then bade him fight to the last.

The *Nelson*, armed with one small gun, replied to the enemy's fire until the heavy heel which she had assumed made it impossible to bring the gun to bear. As she was then on the point of sinking the mate decided to abandon her and take to the boat, and begged his father to give them leave to carry him. This, however, the old man sternly refused to do, and ordered his son to throw him overboard.

The nature of his wounds being such that he would have died if he had been moved, they deemed it best, after consultation, to leave him where he lay. Accordingly, yielding to his reiterated order to abandon the ship, they left this most gallant seaman lying in his blood, and embarked in the boat as the *Nelson* sank.

The submarine in the meanwhile concentrated her fire on the *Ethel and Millie*, and having eventually sunk her, made the survivors of the crew prisoners, and steamed away.

The crew of the *Nelson* were rescued by a man-of-war after being in their boat for forty-four hours.

The second case occurred in the Adriatic. On the night in question our drifter patrol in the Straits of Otranto was attacked by a force of Austrian light cruisers. The drifters were each armed with a 8-pounder gun, and

the light cruisers with 4-inch and 6-inch guns. The drifters were, of course, quite unable to defend themselves. Nevertheless the indomitable skipper, I. Watt, of the drifter *Gowan Lea*, when summoned to surrender by an Austrian light cruiser which was firing at his craft, shouted defiance, waved his hat to his men, and ordered them to open fire with the 3-pounder gun. His orders were obeyed, and, surprising to relate, the light cruiser sheered off, and this fine seaman with his gallant ship's company brought the *Gowan Lea* into port in safety.

Admiral Sir Reginald Bacon, in his most interesting narrative of the work of the Dover Patrol, has brought to light many individual instances of work gallantly performed; it is much to be hoped that before recollection fades, those who can speak of the actions of individuals in other areas will tell their countrymen something of the great deeds performed.

A feature of the patrol service of much interest was the manner in which a large number of retired officers, including many of flag rank—who had reached mature age—volunteered for service in the yachts and other small craft engaged in the work. The late Admiral Sir Alfred Paget was one of the first, if not the first, to come forward, and in order to avoid any difficulty in the matter of rank, this fine veteran proposed to sink his Naval status and to accept a commission as captain of the Royal Naval Reserve. Sir Alfred, in common with many other officers who took up this work, was over sixty, but age did not deter these gallant seamen from facing the hardship and discomfort of service in small craft in the North Sea and elsewhere. To name all the officers who undertook this duty, or who were in charge of patrol areas, would be impossible, and it may seem invidious to mention names at all; but I cannot forbear to speak of

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some of those with whom I came most frequently into contact during 1917. Sir James Startin, K.C.B., who was the life and soul of the patrols and minesweepers working from Granton, was frequently at sea in decoy ships fitted out there, as well as in minesweepers, etc., and together with his son won the Albert Medal for saving life during the war; Admiral J. L. Marx, C.B., D.S.O., served also in a decoy ship; Admiral John Denison, D.S.O., was in charge first at Falmouth and later at Kingstown; Admiral T. P. Walker, D.S.O., had his yacht sunk under him; Admiral Sir Charles Dare, K.C.M.G., C.B., won great distinction in command of the patrols, etc., working from Milford Haven; and Rear-Admiral C. H. Simpson's Peterhead trawlers, splendidly manned, took a heavy toll of enemy submarines. A large number of retired Naval officers below the rank of admiral served in minesweepers and patrol craft, and in command of various areas, and their work was of the greatest possible value. A few of those with whom I came into personal contact during the year 1917 were the late Captain F. Bird, C.M.G., D.S.O., who was most conspicuous in command of the drifters of the Dover Patrol; Captain W. Vansittart Howard, D.S.O., who commanded the Dover Trawler Patrol with such ability; Commander Sir George Armstrong, Bart., who so successfully inspired the minesweeping force working from Havre; and Commander H. F. Cayley, D.S.O., whose services in the Harwich minesweeping force, working under his brother, Rear-Admiral C. G. Cayley, were invaluable.

So much for the patrol craft. The great work carried out by the minesweepers can be best judged by quoting a few figures for 1917, during which year the mine menace attained its maximum intensity, owing to the

large increase in the number of German submarine minelayers.

During the year 1916 the average number of mines swept up per month was 178.

Statistics for 1917 show the following numbers of mines swept up per month :

January	...	...	...	...	250
February	...	...	...	...	380
March	...	...	...	...	478
April	...	...	...	...	515
May	...	...	...	...	360
June	...	...	...	...	470
July	...	...	...	...	404
August	...	...	...	...	352
September	...	...	...	...	418
October	...	...	...	...	237
November	...	...	...	...	184
December	...	...	...	...	188

making the average per month in 1917 355 mines.

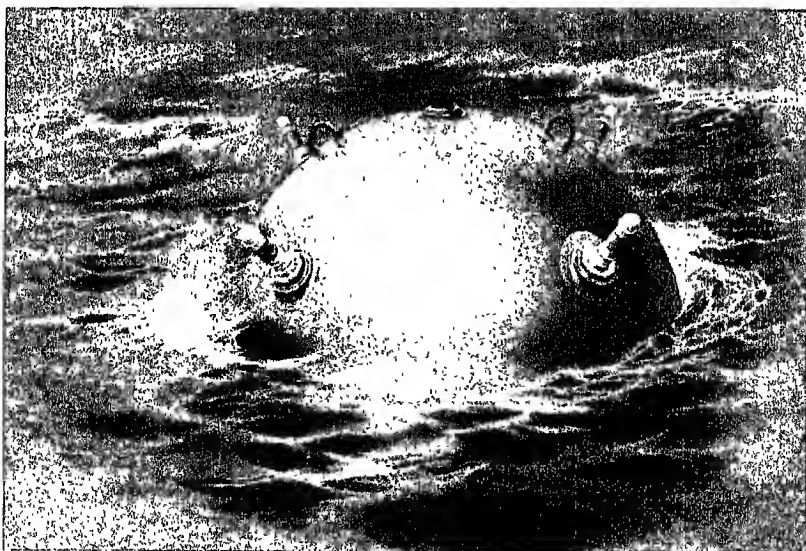
It will be noticed how rapidly the figures rose in the early part of the year, and how great was the diminution in the figures for the later months. This decrease was due to the fact that the extension of anti-submarine measures was beginning to take effect, and the destruction of German submarines, and especially of submarine minelayers of the U.C. type, was becoming considerable.

The heavy work involved a great strain on the mine-sweeping service, and the greatest possible credit is due to the personnel of that service for the fine response made to the call for additional exertions and heavier risks.

At the same time the organizing work achieved at



A Paddle Minesweeper.



A German Mine on the Surface.

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Headquarters by the minesweeping section of the Naval Staff should not be forgotten. At the head of this section was Captain Lionel G. Preston, C.B.; he had succeeded to the post of Head of the Minesweeping Service early in 1917, after two and a half years of strenuous and most successful minesweeping work in the Grand Fleet flotillas, and he at once grappled with the task of dealing with the large number of mines then being laid by German submarines.

Instructions were issued to fit all patrol craft round the coast for minesweeping work in addition to their patrol duties, and they were used for sweeping as required. Many drifters were also fitted for minesweeping in addition to the trawlers hitherto employed; and although there was some prejudice against these vessels on account of their slower speed, they proved to be of great assistance. Every available small craft that could be fitted for the work was pressed into the service, including a considerable number of motor launches.

There was unfortunately great delay in the building of the "Hunt" class of minesweeper, which was the type ordered in 1916 and repeated in 1917, and in spite of very large additional orders for this class of vessel having been placed early in 1917 (a total of 100 extra vessels being ordered), the number completed during that year was only sixteen, together with a single paddle sweeper. Consequently we were dependent for the largely increased work on improvised craft, and the very greatest credit is due to all who were concerned in this arduous and dangerous duty that the waters were kept comparatively clear of mines, and that our losses from this cause were so small when the immense number of mines swept up is considered.

Fortunately the enemy lost very heavily in submarines

of the U-C, or minelaying type, largely because they were working of necessity in waters near our coast, so that our anti-submarine measures had a better chance, since they were easier to locate and destroy than submarines working farther afield. By the commencement of 1918 the average number of mines swept up monthly showed a very remarkable decrease, the average for the first two months of that year being only 159 per month, eloquent testimony to the efficiency of the anti-submarine measures in operation during 1917. I have no information as to the figures for the remaining months of 1918.

The record of minesweeping work would not be complete without figures showing the damage caused by mines to minesweeping vessels.

During the last six months of 1916 the average number of these craft sunk or damaged by mines *per month* was 5.7, while for the first six months of 1917 the figures rose to ten per month. For the second six months of 1917 the figures fell to four per month, a reduction even on the losses towards the end of 1916, in spite of the fact that more mines were being dealt with. This reduction may have been due to improvements effected in organization as the result of experience.

Similarly the total number of merchant ships sunk or damaged by mines, which during the first six months of 1917 totalled 90, dropped in the second six months to 49.

By far the greater proportion of mines swept up were laid in Area 10—i.e. the Nore, Harwich and Lowestoft area. This part of the coast was nearest to the German submarine base at Zeebrugge, and as the greater part of the east coast traffic passed through the area it naturally came in for a great deal of minelaying attention. Out of some 2,400 mines swept up in the first half of 1917,

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over 800 came from Area 10 alone. The greatest number of casualties to merchant ships from mines during this same period also occurred in Area 10, which in this respect was, however, rivalled by Area 8—the Tyne. Many ships also struck mines in Areas 11 and 12 in the English Channel, and in both of these areas a considerable number of mines were swept up.

In addition to the daily risks of being themselves blown up which were run by the vessels engaged in this work, many very gallant deeds were performed by individual officers and men of the minesweeping force, who were one and all imbued with the idea that their first duty was to keep a clear channel for traffic regardless of the consequence to themselves. I must leave to abler pens than mine the task of recording in fitting phrase some of the courageous actions of our small craft which will be looked upon as amongst the most glorious episodes of the Naval part of the Great War, and content myself to mention only one case, that of the trawler *Grand Duke*, working in the Milford area in May, 1917. In this instance a flotilla of minesweepers was employed in sweeping when two mines exploded in the sweep towed by the second pair of minesweeping trawlers in the flotilla. The wire parted and one of the two trawlers proceeded to heave in the "kite," the contrivance employed to keep the sweep at the required depth. When hove short up it was discovered that a mine was foul of the wire and that it had been hauled up against the ship's side. Just beneath the surface the circular outline of a second mine could also be detected entangled in the wire and swirling round in the current beneath the trawler's counter. In the circumstances, since any roll of the ship might suffice to strike one of the horns of either mine and detonate the charges, the officer in charge of

the trawler chose the best course open to him in view of his responsibility for the lives of those under his command, and ordered the trawler to be abandoned.

The senior officer of the division of minesweepers thereupon called for a volunteer, and accompanied by the engineman, boarded the abandoned trawler, and disregarding the imminent probability of an explosion caused by the contact of the ship and the mine, cut the sweep and kite wires. The mines fell clear without detonating, and by means of a rope passed to another trawler they were towed clear of the spot.

It is appropriate to close this chapter by giving a synopsis of the losses amongst our patrol escort and minesweeping vessels between the commencement of the war and the end of 1917 due (1) to enemy action, and (2) to the increased navigational dangers incidental to service afloat under war conditions.

Under the first heading—enemy action—the losses were 8 yachts, 6 motor launches, 3 motor boats, 150 trawlers, 59 drifters, and 10 paddle minesweepers; and the losses due to navigational risks were 5 yachts, 55 trawlers, 7 motor launches, 3 motor boats, 30 drifters, and 1 paddle minesweeper, whilst the total loss of life was 197 officers and 1,782 men.

CHAPTER VIII

THE DOVER PATROL AND THE HARWICH FORCES

VICE-ADMIRAL SIR REGINALD BACON has given * a most valuable record of the varied work carried out in the Straits of Dover and on the Belgian coast during the period of his command. There is little to be added to this great record, but it may be of interest to mention the general Admiralty policy which governed the Naval operations in southern waters during the year 1917, and the methods by which that policy was carried out.

The policy which was adopted in southern waters, and especially in the Straits of Dover, was that, so far as the means at our disposal admitted, the Straits should be rendered impassable for enemy ships of all kinds, from battleships to submarines, with a view to protecting the cross-Channel communications of our Army in France, of affording protection to trade in the Channel, and preventing a military landing by the Germans either in the south of England or on the left flank of the Allied Army in France. So long as the Belgian coast ports remained in German possession, the Naval force that could be based there constituted a very serious menace to the cross-Channel traffic. This really applied more to destroyers than to submarines, and for this reason: submarines have an infinitely larger radius of action than destroyers, and if the Belgian coast ports had not been in German occupation, the additional 210 miles from the

* "The Dover Patrol, 1915-1917." (Hutchinson & Co., 1919.)

Ems would not have been a matter of serious moment to them, and if sighted on the longer passage they could submerge. The case was quite different with destroyers or other surface vessels; in the first place they were open to attack by our vessels during the passage to and from the Ems, and in the second the additional distance to be traversed was a matter for consideration, since they carried only limited supplies of fuel.

A fact to which the Admiralty frequently directed attention was that, although annoyance and even serious inconvenience might be caused to the enemy by sea and air operations against Ostend and Zeebrugge, no *permanent* result could be achieved by the Navy alone unless backed up by an advance on land. The Admiralty was heart and soul for an audacious policy, providing the form of attack and the occasion offered a reasonable prospect of success. Owing to the preoccupations of the Army, we had to be satisfied with bombardments of the ports by unprotected monitors, which had necessarily to be carried out at very long ranges, exceeding 25,000 yards, and necessitating direction of the fire by aircraft.

Bruges, about eight miles from the sea, was the real base of enemy submarines and destroyers, Zeebrugge and Ostend being merely exits from Bruges, and the use of the latter could only be denied to the enemy by land attack or by effective blocking operations at Ostend and Zeebrugge, for, if only one port was closed, the other could be used.

Neither Zeebrugge, Ostend, nor Bruges could be rendered untenable to the enemy with the guns available during 1917, although Ostend in particular, and Zeebrugge to a lesser extent, could be, and were frequently, brought under fire when certain conditions prevailed, and some temporary damage caused. Indeed, the fire

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against Ostend was so effective that the harbour fell into disuse as a base towards the end of 1917. We were arranging also in 1917 for mounting naval guns on shore that would bring Bruges under fire, after the enemy had been driven from Ostend by the contemplated operation which is mentioned later. When forced to abandon this operation, in consequence of the military advance being held up by the weather, these guns were mounted in monitors.

In the matter of blocking the entrance to the ports of Zeebrugge and Ostend, the fact had to be recognized that effective *permanent* blocking operations against destroyers and submarines were not practicable, mainly because of the great rise and fall above low water at ordinary spring tides, which is 14 feet at Ostend and 18 feet at Zeebrugge for about half the days in each month. Low water at Ostend also lasts for one hour. Therefore, even if block-ships were sunk in the most favourable position the operation of making a passage by cutting away the upper works of the block-ships was not a difficult matter, and the Germans are a painstaking people. This passage could be used for some time on each side of high water by vessels like destroyers drawing less than 14 feet, or submarines drawing, say, 14 feet. The block would, therefore, be of a temporary and not a permanent nature, although it would undoubtedly be a source of considerable inconvenience. At the same time it was realized that, although permanent blocking was not practicable, a temporary block would be of use, and that *the moral effect alone of such an operation would be of great value*. These considerations, together with the abandonment of the proposed landing on the Belgian coast, owing to unfavourable military conditions, led to the decision late in 1917 to undertake blocking

operations concurrently with an attack on the vessels alongside the Mole at Zeebrugge.

In order to carry out the general policy mentioned, the eastern end of the Straits of Dover had been heavily mined at intervals during the war, and these mines had proved to be a sufficient deterrent against any attempt on the part of surface vessels larger than destroyers to pass through. Owing to the rise of tide enemy destroyers could pass over the minefields at high water without risk of injury, and they frequently did so pass. Many attempts had been made to prevent the passage of enemy submarines by means of obstructions, but without much success; and at the end of 1916 a "mine net barrage"—i.e. a series of wire nets of wide mesh carrying mines—was in process of being placed by us right across the Straits from the South Goodwin Buoy to the West Dyck Bank, a length of 28 miles, it being arranged that the French would continue the barrage from this position to the French coast. The construction of the barrage was much delayed by the difficulty in procuring mooring buoys, and it was not completed until the late summer of 1917. Even then it was not an effective barrier owing to the tidal effects, as submarines were able to pass over it during strong tides, or to dive under the nets as an alternative; it was not practicable to use nets more than 60 feet deep, whilst the depth of water in places exceeded 120 feet.

Deep mines were laid to guard the water below the net, but although these were moored at some considerable distance from the barrage, trouble was experienced owing to the mines dragging their moorings in the strong tide-way and fouling the nets. One series had to be entirely swept up for this reason. Many devices were tried with the object of improving this barrage, and many clever

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brains were at work on it. *And all the time our drifters with their crews of gallant fishermen, with Captain Bird at their head, worked day after day at the task of keeping the nets efficient.*

In spite of its deficiencies the barrage was believed to be responsible for the destruction of a few submarines, and it did certainly render the passage of the Straits more difficult, and therefore its moral effect was appreciable. Towards the end of 1917, however, evidence came into our possession showing that more submarines were actually passing the Straits of Dover than had been believed to be the case, and it became a question whether a proportion of the drifters, etc., required for the maintenance of the nets of the barrage should be utilized instead for patrol work in the vicinity of the mine barrage then being laid between Folkestone and Cape Grisnez. This action was taken, drifters being gradually moved to the new area.

In April, 1916, a net barrage, with lines of deep mines on the Belgian side of the nets, had also been laid along the Belgian coast covering the exits from the ports of Ostend and Zeebrugge as well as the coast between those ports. These nets were laid at a distance of some 24,000 yards from the shore. This plan had proved most successful in preventing minelaying by submarines in the Straits of Dover, and the barrage was maintained from May to October, but the weather conditions had prevented its continuance from that date.

The operation was repeated in 1917, the barrage being kept in position until December, when the question of withdrawing the craft required for its maintenance for patrol work in connection with the minefield laid on the Folkestone-Grisnez line came under discussion.

The Belgian coast barrage being in the nature of a surprise was probably more useful as a deterrent to sub-

marine activity in 1916 than in 1917. In both years a strong patrol of monitors, destroyers, mincsweepers, drifters for net repairs, and other vessels was maintained in position to the westward of the barrage to prevent interference with the nets by enemy vessels and to keep them effective.

These vessels were patrolling daily within 13 or 14 sea miles of the two enemy destroyer and submarine bases, and although occasionally attacked, were not driven off in spite of the superior destroyer force which the enemy could always bring to bear. In 1917 actions between our vessels and those of the enemy, and between our own and enemy aircraft, were of very frequent occurrence. The Germans also introduced a new weapon in the form of fast motor boats controlled by a cable from the shore and guided by signals from aircraft, these boats being heavily loaded in the fore part with explosives which detonated on contact with any vessels attacked. On only one occasion in four attacks were the boats successful in hitting their mark, and the monitor *Terror*, which was struck in this instance, although considerably damaged in her bulge protection, was successfully brought back to port and repaired.

Whilst our monitors were on patrol near the barrage, as well as on other occasions, every favourable opportunity was taken of bombarding the bases at Zeebrugge and Ostend. In the former case the targets fired at were the lock gates, and in the latter the workshops, to which considerable damage was frequently occasioned, as well as to vessels lying in the basin.

These bombardments were carried out in 1917 at distances exceeding 25,000 yards. The long range was necessary on account of the net barrage, and also because of the rapidity with which the "Knocke" and "Tirpitz"

shore batteries obtained the range of monitors attacking them, one hit on an unprotected monitor being sufficient to sink her.

They were also invariably carried out under the protection of a smoke screen; in the autumn of 1917 the enemy commenced to start a smoke screen himself as soon as we opened fire, thus interfering with our observation of fire even from aircraft, but in spite of this much damage resulted from the bombardments. Our observation of fire being necessarily carried out by aircraft, and the enemy attempting similar measures in his return gunfire, resulted in aerial combats over the monitors being a frequent occurrence.

The carefully organized arrangements made by Admiral Bacon for these coastal bombardments excited my warm admiration. He left nothing to chance, and everything that ingenuity could devise and patient preparation could assist was done to ensure success. He received assistance from a staff which, though small in number, was imbued with his own spirit, and he brought to great perfection and achieved wonderful success in methods of warfare of which the Navy had had no previous experience.

During the year 1917 aerial bombing attacks were persistently carried out on the German naval bases in Belgium by the Royal Naval Air Force at Dunkirk, which came within the sphere of the Dover Command. These attacks had as their main object the destruction of enemy vessels lying in these bases, and of the means for their maintenance and repair. The attacks, under the very skilful direction of Captain Lambc, R.N., were as incessant as our resources and the weather admitted, and our gallant and splendidly efficient airmen of the R.N.A.S. were veritable thorns in the sides of the Germans. Our bombing machines as well as our fighting

aircraft were often required to attack military instead of naval objectives, and several squadrons of our fighting machines were lent to the military for the operations carried out during the year on the Western Front; they did most excellent work, and earned the high commendation of Sir Douglas Haig.* But we were still able to work against naval objectives. Zeebrugge, for instance, was bombed on seven nights during April and five nights during May, and during September a total weight of 86 tons of bombs was dropped on enemy objectives by the Dunkirk Naval aircraft, and we had good reason to be satisfied with the results achieved. During this same month 18 enemy aircraft were destroyed and 48 driven down. Attacks upon enemy aerodromes were very frequent, and this form of aerial offensive undoubtedly exercised a very deterrent influence upon enemy aerial activity over England. Two submarines also were attacked and were thought to be destroyed, all by our machines from Dunkirk. To Commodore Godfrey Paine, the Fifth Sea Lord at the Admiralty, who was in charge of the R.N.A.S., and to the staff assisting him our thanks were due for the great work they accomplished in developing new and efficient types of machines and in overcoming so far as was possible the difficulties of supply. The amount of bombing work carried out in 1917 cannot, of course, compare with that accomplished during 1918, when production had got into its stride and the number of machines available was consequently so very much larger.

Whether it was due to our aerial attacks on Bruges that the German destroyers in the autumn months frequently left that base and lay at Zeebrugge cannot be known, but they did so, and as soon as we discovered this fact by aerial photographs, plans were laid by Sir Reginald

* Now Earl Haig.

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Bacon for a combined naval and aerial night operation. The idea was for the aircraft to bomb Zeebrugge heavily in the vicinity of the Mole, as we ascertained by trial that on such occasions the enemy's destroyers left the Mole and proceeded outside the harbour. There we had our coastal motor boats lying off waiting for the destroyers to come out, and on the first occasion that the operation was carried out one German destroyer was sunk and another believed to have been damaged, if not also sunk, by torpedoes fired by the coastal motor boats, to which very great credit is due for their work, not only on this, but on many other occasions; these boats were manned by a very gallant and enterprising personnel.

Numerous other operations against enemy destroyers, torpedo boats and submarines were carried out during the year, as recounted in Sir Reginald Bacon's book, and in the autumn, when supplies of the new pattern mines were becoming available, some minelaying destroyers were sent to Dover; these vessels, as well as coastal motor boats and motor launches, were continually laying mines in the vicinity of Zeebrugge and Ostend with excellent results, a considerable number of German destroyers and torpedo boats working from Zeebrugge being known to have been mined, and a fair proportion of them sunk by these measures.

In addition to the operations carried out in the vicinity of the Belgian coast, the Dover force constantly laid traps for the enemy destroyers and submarines in waters through which they were known to pass.

Lines of mined nets laid across the expected track of enemy vessels was a device frequently employed; submarines, as has been stated, were used on the cross-Channel barrage to watch for the passage of enemy submarines and destroyers, and everything that ingenuity

could suggest was done to catch the German craft if they came out.

Such measures were supplementary to the work of the destroyers engaged on the regular Dover Patrol, the indomitable Sixth Flotilla.

A great deal depended upon the work of these destroyers. They formed the principal, indeed practically the only, protection for the vast volume of trade passing the Straits of Dover as well as for our cross-Channel communications. When the nearness of Zeebrugge and Ostend to Dover is considered (a matter of only 72 and 62 miles respectively), and the fact that one and sometimes two German flotillas, each comprising eleven large and heavily armed torpedo-boat destroyers, were usually based on Bruges, together with a force of large modern torpedo boats and a very considerable number of submarines, it will be realized that the position was ever one of considerable anxiety. It was further always possible for the enemy to send reinforcements of additional flotillas from German ports, or to send heavier craft with minesweepers to sweep a clear channel, timing their arrival to coincide with an intended attack, and thus to place the German forces in a position of overwhelming superiority.

Our own Dover force at the commencement of 1917 consisted of one light cruiser, three flotilla leaders, eighteen modern destroyers, including several of the old "Tribal" class, eleven old destroyers of the 80-knot class (the latter being unfit to engage the German destroyers), and five "P" boats. Of this total the average number not available at any moment may be taken as at least one-third. This may seem a high estimate, but in addition to the ordinary refits and the time required for boiler cleaning, the vessels of the Dover Patrol working in very dangerous, foggy and narrow waters suffered heavy

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casualties from mines and collisions. The work of the Dover force included the duty of escorting the heavy traffic between Dover and Folkestone and the French ports, this being mostly carried on during daylight hours owing to the prevalence of submarine-laid mines and the necessity for sweeping the various channels before the traffic—which included a very large troop traffic—was allowed to cross. An average of more than twenty transports and hospital ships crossed the Straits daily during 1917, irrespective of other vessels. The destroyers which were engaged during daylight hours in this work, and those patrolling the barrages across the Straits and off the Belgian coast, obviously required some rest at night, and this fact reduced the number available for duty in the dark hours, the only time during which enemy destroyer attacks took place.

Up to the spring of 1917 the examination service of all vessels passing the Straits of Dover had been carried out in the Downs. This led to a very large number of merchant ships being at anchor in the Downs at night, and these vessels were obviously open to attack by enemy craft of every description. It was always a marvel to me that the enemy showed such a lack of enterprise in failing to take advantage of these conditions. In order to protect these vessels to some extent, a light cruiser from Dover, and one usually borrowed from Harwich, together with a division of destroyers either from Dover, or borrowed also from Harwich, were anchored off Ramsgate, and backed by a monitor if one was available, necessitating a division of strength and a weakening of the force available for work in the Straits of Dover proper.

The result of this conflict of interests in the early part of the year was that for the patrol of the actual Straits in the darkness of night on a line some 30 miles in length,

the number of vessels available rarely if ever exceeded six—viz. two flotilla leaders and four destroyers, with the destroyers resting in Dover (four to six in number) with steam ready at short notice as a reserve.

An attack had been made on the Dover Patrol in October, 1916, which had resulted in the loss by us of one destroyer and six drifters, and serious damage to another destroyer. A consideration of the circumstances of this attack after my arrival at the Admiralty led me to discuss with Sir Reginald Bacon the question of keeping such forces as we had in the Straits at night concentrated as far as possible. This disposition naturally increased the risk of enemy vessels passing unobserved, but ensured that they would be encountered in greater, although not equal, force if sighted.

Steps were also taken to reduce the tempting bait represented by the presence of so many merchant ships in the Downs at night. Sir Reginald Bacon proposed that the portion of the examination service which dealt with south-going ships should be moved to Southend, and the transfer was effected as rapidly as possible and without difficulty, thereby assisting to free us from a source of anxiety.

During the early part of 1917 the enemy carried out a few destroyer raids both on English coast towns in the vicinity of Dover and the French ports of Dunkirk and Calais. As a result of these raids, which, though regrettable, were of no military importance, a good deal of ill-informed criticism was levelled at the Admiralty and the Vice-Admiral commanding at Dover. To anyone conversant with the conditions, the wonder was not that the raids took place, but that the enemy showed so little enterprise in carrying out—with the great advantages he possessed—operations of real, if not vital, military value.

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The only explanation is that he foresaw the moral effect that his tip-and-run raids would produce; and he considered that the effect of the resulting agitation might be of no inconsiderable value to himself; the actual damage done was almost negligible, apart from the loss of some eight lives, which we all deplored. It is perhaps natural that people who have never experienced war at close quarters should be impatient if its consequences are brought home to them. A visit to Dunkirk would have shown what war really meant, and the bearing of the inhabitants of that town would have taught a valuable lesson.

The conditions in the Straits have already been mentioned, but too much emphasis cannot be laid on them. The enemy who possessed the incalculable advantage of the initiative, had at his disposal, whenever he took heart to plan an attack, a force of at least twenty-two very good destroyers, all unfortunately of higher speed than anything we could bring against them, and more heavily armed than many of our destroyers. This force was based within seventy miles of Dover, and as the Germans had no traffic of any sort to defend, was always available for offensive operations against our up and down or cross-Channel traffic. Our Dover force was inferior even at full strength, but owing to the inevitable absence of vessels under repair or refitting and the manifold duties imposed upon it, was bound to be in a position of marked inferiority in any night attack undertaken by the Germans against any objective in the Straits.

The enemy had a great choice of objectives. These were: first, the traffic in the Channel or the destroyers watching the Straits (the most important military objective); second, the merchant ships anchored in the Downs; third, the British monitors anchored off

Dunkirk; fourth, the French ports, Dunkirk, Boulogne and Calais, and the British port of Dover; and fifth, the British undefended towns of Ramsgate, Margate, Lowestoft, etc., which German mentality did not hesitate to attack.

A glance at Chart F will show how widely separated are these objectives and how impossible it was for the small Dover force to defend them all simultaneously, especially during the hours of darkness. Any such attempt would have led to a dispersion of force which would have been criminal. The distance from Dunkirk along the French coast to Calais, thence to Dover and along the English coast to the North Foreland is 60 miles. The distance at which an enemy destroyer can be seen at night is about a quarter of a mile, and the enemy could select any point of the 60 miles for attack, or could vary the scene of operations by bombarding Lowestoft or towns in the vicinity, which were only 80 miles from Zeebrugge and equally vulnerable to attack, since the enemy's destroyers could leave their base before dark, carry out their hurried bombardment, and return before daylight. In whatever quarter he attacked he could be certain of great local superiority of force, although, of course, he knew full well that the first sign of an attack would be a signal to our forces to try to cut him off from his bases. Therein lay the reason for the tip-and-run nature of the raids, which lasted for a few minutes only. The enemy realized that we should endeavour to intercept his force as soon as it had disclosed its presence. The Germans had naturally to take the risk of encountering our vessels on the way to his objectives, but at night this risk was but slight.

As it was obviously impossible to prevent bombardments by stationing destroyers in adequate force for

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the protection of each town, the only possible alternative, unless such bombardments were ignored, was to give the most vulnerable points protection by artillery mounted on shore. This was a War Office, not an Admiralty, responsibility; but as the War Office had not the means available, the Admiralty decided to take the matter in hand, and in the spring of 1917 some 6-inch naval guns taken from our reserves were mounted in the vicinity of the North Foreland. Further, an old monitor, which was of no use for other work owing to her machinery being unfit, was moored to the southward of Ramsgate, and her guns commanded the Downs. Searchlights were also mounted on shore, but more reliance was placed on the use of star shells, of which the earliest supplies were sent to these guns. The result was immediately apparent. German destroyers appeared one night later on off the North Foreland and opened fire, which was returned by the monitor and the shore guns. The enemy immediately withdrew, and never appeared again in 1917 in this neighbourhood.

Meanwhile efforts had been made to increase the strength of the Dover force, and by the end of June it stood at 4 flotilla leaders, 29 modern destroyers (including "Tribal" class), 10 old 30-knotters, and 6 "P" boats. The increase in strength was rendered possible owing to the relief of destroyers of the "M" and "L" classes at Harwich by new vessels recently completed and by the weakening of that force numerically. The flotilla leaders were a great asset to Dover, as, although they were coal-burning ships and lacked the speed of the German destroyers, their powerful armament made it possible for them to engage successfully a numerically greatly superior force. This was clearly shown on the occasion of the action between the *Broke* and *Swift* and a

German force of destroyers on the night of April 20-21, 1917.

The flotilla leaders on that occasion were, as was customary, patrolling at the Dover end of the cross-Channel barrage. The enemy's destroyers were in two detachments. One detachment, consisting apparently of four boats, passed, it was thought, round the western end of the barrage at high tide close to the South Goodwin Buoy, and fired a few rounds at Dover. The other detachment of two boats went towards Calais, and the whole force seems to have met at a rendezvous prior to its return to its base.

The *Broke* and *Swift* intercepted them on their return, and after a hot engagement succeeded in sinking two of the enemy vessels, one being very neatly rammed by the *Broke* (Captain E. R. G. R. Evans, C.B.), and the second sunk by torpedoes. Some of the remaining four boats undoubtedly suffered serious damage. Our flotilla leaders were handled with conspicuous skill, and the enemy was taught a lesson which resulted in his displaying even greater caution in laying his plans and evincing a greater respect for the Dover force for many months.

The success of the *Broke* and *Swift* was received with a chorus of praise, and this praise was undoubtedly most fully deserved, but once again an example was furnished of the manner in which public attention becomes riveted upon the dramatic moments of naval warfare whilst the long and patient labour by which the dramatic moments are brought about is ignored.

Thus in this case but little attention was drawn to the years of arduous work performed by the Sixth Flotilla in the Straits of Dover by day and by night, in dense fogs, heavy gales and blinding snowstorms, in waters which were constantly mined, and in the face of an enemy

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who was bound to be in greatly superior force whenever he chose to attack.

Little thought was given either to the wonderful and most gallant work carried out by the drifters of the Patrol, manned largely by fishermen, and practically defenceless against attack by the German destroyers.

The careful organization which conduced to the successful action was forgotten. Sir Reginald Bacon has told the story of all this work in his book, and I need not repeat it. But let it be added that victory depends less on such enheartening incidents, welcome as they are, than on the patient and usually monotonous performance of duty at sea by day and by night in all weathers, and on the skill in organization of the staff ashore in foreseeing and forestalling enemy activity on a hundred and one occasions of which the public necessarily knows nothing.

It has been stated that reliable information reached us in the autumn of 1917 that enemy submarines were passing the Straits of Dover in much greater numbers than we had hitherto believed to be the case, and the inefficiency of the net barrage in preventing the passage was apparent.

Early in the year (in February) Sir Reginald Bacon had put forward a proposal for a deep minefield on the line Folkestone—Cape Grisnez, but confined only to the portion of the line to the southward of the Varne Shoal.

It was known that enemy submarines as a rule made this portion of their passage submerged, and the minefield was designed to catch them.

The proposal was approved after personal discussion with Admiral Bacon, and directions were given that the earliest supplies of the new pattern mines were to be allocated for this service; these mines commenced to

become available early in the following November, and were immediately laid.

Admiral Bacon suggested later the extension of the minefield to the westward of the Varne Shoal, so as to make it a complete barrier across the Channel. This was also approved and measures were taken to provide the necessary mines.

The question of illuminating at night the area covered by the deep minefield was also discussed at length with Sir Reginald Bacon. Various proposals were considered, such as the use of searchlights on Cape Grisnez and at Folkestone, together with the provision of small light-ships fitted with searchlights and moored at intervals across the Channel, and also the use of flares from patrol craft. Flares had already been experimented with from kite balloons by the Anti-Submarine Division of the War Staff, and they were found on trial to be efficient when used from drifters, and of great use in illuminating the patrol area so that the patrol craft might have better opportunities for sighting submarines and the latter be forced to dive into the minefields.

A committee had been meanwhile appointed by the First Lord to consider the question of the Dover Barrage in the light of the information we then possessed as to the passage of enemy submarines through the Straits of Dover. This committee visited Dover on several occasions, and its members, some of whom were naval officers and some civilian engineers, were shown the existing arrangements.

The committee, which considered at first the question of providing an *obstruction*, ended by reporting that the existing barrage was inefficient (a fact which had become apparent), and made proposals for the establishment of the already approved minefield on the Folkestone—

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Grisnez line. I do not recollect that any definite new ideas were evolved as the outcome of the labours of this committee; some ideas regarding the details of the minefield, particularly as to the best form of obstruction that would catch submarines or other vessels on the surface, were put forward, as also some proposals for erecting towers in certain positions in the Straits. I do not think that these latter ever matured. The manner in which the minefield should be illuminated at night was discussed by the committee, and arrangements were made for the provision of the vessels proposed by Admiral Bacon.

Some disagreement arose on the subject of the provision of the necessary number of vessels for patrolling the minefield with a view to forcing the submarines to dive. In my view a question of this nature was one to be left in the hands of the Vice-Admiral at Dover, with experience on the spot, after I had emphasized to him the extreme importance attached to the provision of an ample number of patrol craft at the earliest possible moment. Interference by the Admiralty in such a detail of a flag officer's command would in my opinion have been dangerous and incorrect, for so long as a flag officer retains the confidence of the Board he must be left to work his command in the manner considered best by him after having been informed of the approved general policy, since he is bound to be acquainted with the local situation to a far greater extent than any officer serving at the Admiralty or elsewhere. I discussed the matter personally with Sir Reginald Bacon, and was satisfied that he was aware of the views held by me and of the necessity for providing the patrol craft even at the expense of other services, as soon as he could make the requisite arrangements.

Sir Reginald Bacon's three years' experience at Dover was a great asset in dealing with this matter, as with

other questions connected with the Command, more especially the difficult and embarrassing operations on the Belgian coast. His ingenuity, originality, patience, power of organization and his methodical preparations for carrying out operations were always a great factor in ensuring success. These qualities were never shown more clearly than during the preparations made for landing a force of some 14,000 officers and men with tanks, artillery and transport on the coast of Belgium under the very muzzles of the German heavy coast artillery. It was estimated that the whole force would be put on shore in a period of twenty minutes. The scheme is described in full in Chapter IX. of the first volume of Sir Reginald Bacon's book on the Dover Patrol. He had put the proposal before Admiral Sir Henry Jackson, my predecessor, who had expressed his concurrence so far as the naval portion of the scheme was concerned, and provided that the army made the necessary advance in Flanders. When the scheme was shown to me shortly after taking office as First Sea Lord I confess that I had some doubts as to the possibility of manœuvring two monitors, with a pontoon 550 feet in length secured ahead of and between the bows of the monitors, but in view of the immense importance of driving the Germans from the Belgian coast and the fact that this scheme, if practicable, promised to facilitate greatly such an operation, approval was given for the construction of a pontoon, and after witnessing the first trials of the pontoon secured between two monitors which were themselves lashed together, I became convinced that this part of the operation was perfectly feasible. The remaining pontoons were therefore constructed, and preparations commenced in the greatest secrecy for the whole operation.

The next matter for trial was the arrangement

devised by Sir R. Bacon for making it possible for tanks to mount the sea wall. These trials were carried out with great secrecy against a model of the sea wall built at the Headquarters of the Tank Corps in France, and were quite successful. It was necessary to see actual photographs of the tanks mounting the coping at the top of the sea wall to be convinced of the practicability of the scheme. A matter of great importance was the necessity for obtaining accurate information of the slope of the beach at the projected landing places in order that the practicability of grounding the pontoon could be ascertained. This information Sir R. Bacon, with his characteristic patience and ingenuity, obtained by means of aerial photographs taken at various states of tide.

Finally, to gain exact knowledge of the rise and fall of the tide, Admiral Bacon employed a submarine which submerged in the vicinity of Nieuport and registered the height of water above her hull for a period of twenty-four hours under conditions of spring and neap tides.

The preparations for the landing involved much collaboration with the military authorities, and Sir Reginald Bacon was frequently at G.H.Q. for the purpose. As soon as it was decided that the 1st Division was to provide the landing party, conferences took place between Admiral Bacon and General Sir Henry Rawlinson (now Lord Rawlinson), and I took the opportunity of a visit paid by Sir H. Rawlinson to London to confer with him myself. Subsequently a conference took place at the War Office at which Sir Douglas Haig was present.

There was entire unanimity between the Navy and Army over the proposed operation, and we greatly admired the manner in which the Sister Service took up the work of preparing for the landing. Secrecy was absolutely vital to success, as the whole scheme was

dependent on the operation being a surprise, more particularly in the selection of the landing place. Admiral Bacon describes in his book the methods by which secrecy was preserved. As time passed, and the atrocious weather in Flanders during the summer of 1917 prevented the advance of our Army, it became more and more difficult to preserve secrecy; but although the fact that some operation of the kind was in preparation gradually became known to an increasing number of people, it is safe to say that the enemy never realized until long after the operation had been abandoned its real nature or the locality selected for it.

Some officers with experience of the difficulties encountered during the landings at Gallipoli expressed doubts of the practicability of the operation in the face of the heavy fire from large guns and from machine guns which might be expected, but the circumstances were so different from those at Gallipoli that neither Sir Reginald Bacon nor I shared these doubts. The heavy bombardment of the coast batteries by our own shore guns, which had been greatly strengthened for the purpose, the rapidity of the landing, the use of a dense smoke screen, the fact of the landing being a complete surprise, the use of tanks for dealing with hostile machine guns, the interruption to the enemy's shore communications by heavy artillery fire, and the bombardment by monitors of the coast well to the eastward of the landing place as a feint, were all new factors, and all promised to assist towards success.

Of the supreme importance of the operation there could be no question. Ever since 1914 the Navy had been pressing for the recapture of the ports on the Belgian coast, and they could only be taken by means of a combined operation. Sir John French* himself had in the

* Now Field-Marshal Viscount French.

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early days of the war pointed out the great importance of securing the coast, but circumstances beyond his control were too powerful for him.

It was in these circumstances that the decision to undertake the operation was made, and when it became necessary to abandon it owing to the inability of the Army to co-operate the intense disappointment felt by all those who had worked so hard to ensure its success can be realized.

The Harwich force, consisting of the 5th Light Cruiser Squadron and the flotilla of destroyers, was the only other British force stationed in south-eastern waters if we except the local craft at the Nore. The 5th Light Cruiser Squadron and the flotilla were under the command of Commodore (now Rear-Admiral) Sir Reginald Tyrwhitt, an officer whose vessels were, if we except the Dover patrol, more frequently in contact with the enemy than any other British force in Home waters. Sir Reginald Tyrwhitt had several functions to perform :

(1) It was always hoped that he would be able to join forces with the Grand Fleet should events foreshadow a meeting with the High Sea Fleet.

(2) We depended very largely on him for reconnaissance work in the southern part of the North Sea and into the German Bight.

(3) It fell to his lot as a rule to provide the covering force for aerial operations carried out from seaplane carriers in southern waters.

(4) His force was best placed to cut off any enemy light craft that might be located in southern waters and to attack Zeppelins at sea on their return from raids over England.

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(5) He was called upon almost weekly to cover the passage of the convoy of merchant ships between the Thames and Holland known as the "Dutch Convoy."

(6) He was constantly called upon to provide reinforcements for the Dover Patrol or to assist in operations carried out by the latter force.

These miscellaneous duties involved a great deal of work for the Harwich force and particularly for the destroyers.

The necessity for continually providing reinforcements from the Harwich force for the Dover Patrol was a standing handicap to Sir Reginald Tyrwhitt's operations; he took the matter philosophically, although I always realized how difficult it made his work at times, and whenever, as was frequent, combined operations were carried out by the two forces, the greatest harmony prevailed between the Commands.

At the commencement of 1917 the Harwich force comprised 8 light cruisers, 2 flotilla leaders and 45 destroyers. During the year new vessels were either added to it or replaced older craft which were withdrawn for other services, and at the end of the year the force included 9 light cruisers, 4 flotilla leaders and 24 destroyers.

The force was constantly operating in the outer waters of the Heligoland Bight to seaward of our minefields. The objects of the presence of our ships in these waters, in addition to reconnaissance work and aerial operations, were :

(a) To intercept any enemy light forces which might be intending to operate off our coasts or which might be on passage between German ports.

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(b) To surprise and attack enemy minesweeping vessels.

(c) To destroy Zeppelins either on reconnaissance or raiding work.

(d) To capture enemy merchant ships trading between Dutch and German ports, or neutrals with contraband trading to Germany.

The opportunities that were given to the force under heading (a) were exceedingly rare during the year 1917, when even the light forces of the High Sea Fleet were content to remain almost constantly in port except when engaged in the operations in the Baltic, and excepting also on the two occasions on which attacks were made on the Scandinavian convoy; but a portion of the Harwich force succeeded on one occasion in intercepting a flotilla of German destroyers *en route* to Zeebrugge from German ports with the result that one destroyer was seriously damaged and forced into the Dutch port of Ymuiden and another either sunk or badly damaged.

Forces from Harwich also succeeded in capturing or sinking twenty-four merchant ships trading between Antwerp and Dutch ports and Germany during the year, but the main result of the operations of this force was shown in the refusal of the enemy to risk his vessels except under cover of darkness in the area in which the Harwich force worked.

The duty of protecting the Dutch convoy imposed a heavy strain upon the Harwich force. During the year 1917, 520 eastbound and 511 westbound vessels were convoyed between Dutch and British ports with the loss of only four ships by submarine attack, one by destroyer attack, and one by mine. The price paid by the force for this success was the loss of four destroyers by mines, and

one by collision, and the damage of three destroyers by mine or torpedo, and of five destroyers and one light cruiser by collision. The frequent collisions were due to the conditions under which the traffic was carried out at night without lights, and to the prevalence of fogs. The procedure adopted by the force was frequently changed as it necessarily became known to the Germans.

The extraordinarily small losses in the convoys were a very great tribute to the handling of the protecting force and to the organization in Holland for arranging sailings, when it is borne in mind that it was almost impossible to prevent leakage of information to German agents once the time of sailing was given out, and that the convoys were open to attack from destroyers and submarines operating either from Zeebrugge or from the Ems or other German ports. The orders of course emanated from the Admiralty, and of all the great work achieved by Vice-Admiral Sir Henry Oliver, the Deputy Chief of the Naval Staff, during his service at the Admiralty in the year 1917 and indeed in the two preceding years, the success attending the work of this convoy was certainly not the least.

It is difficult to put into words the great admiration which I felt for Sir Henry Oliver's work throughout the war. Our association commenced during my command of the Grand Fleet, but became of course much closer at the Admiralty, and during my service there his assistance was of immense help to me and of incalculable value to the nation.

It was fortunate indeed for the Allied cause that he held such important Staff appointments during the most critical periods of the war.

CHAPTER IX

THE SEQUEL

THE foregoing chapters have been devoted to describing the measures that were devised or put into force or that were in course of preparation during the year 1917 to deal with the unrestricted submarine warfare against merchant shipping adopted by Germany and Austria in February of that year. It now remains to state, so far as my information admits, the effect of those measures.

British anti-submarine measures were almost non-existent at the commencement of the war. Sir Arthur Wilson, when in command of the Channel Fleet in the early days of the submarine, had experimented with nets as an anti-submarine measure, and shortly before the war submarines were exercised at stalking one another in a submerged condition; also the question of employing a light gun for use against the same type of enemy craft when on the surface had been considered, and some of our submarines had actually been provided with such a gun of small calibre. Two patterns of towed explosive sweeps had also been tried and adopted, but it cannot be said that we had succeeded in finding any satisfactory anti-submarine device, although many brains were at work on the subject, and therefore the earliest successes against enemy submarines were principally achieved by ramming tactics. Gradually other devices were thought out and adopted; these comprised drift and stationary nets fitted with

mines, the depth charge, decoy ships of various natures, gunfire from patrol craft and gunfire from armed merchant ships, as well as the numerous devices mentioned in Chapter III.

Except at the very commencement of the war, when production of craft in Germany was slow, presumably as a result of the comparatively small number under construction when war broke out, the British measures failed until towards the end of 1917 in sinking submarines at a rate approaching in any degree that at which the Germans were producing them.

Thus Germany started the war with 28 submarines; five were added and five were lost during 1914, leaving the number still 28 at the commencement of 1915.

During 1915, so far as our knowledge went, 54 were added and only 19 were lost, the total at the commencement of 1916 being therefore 63.

During 1916 it is believed that 87 submarines were added and 25 lost, leaving the total at the commencement of 1917 at 125.

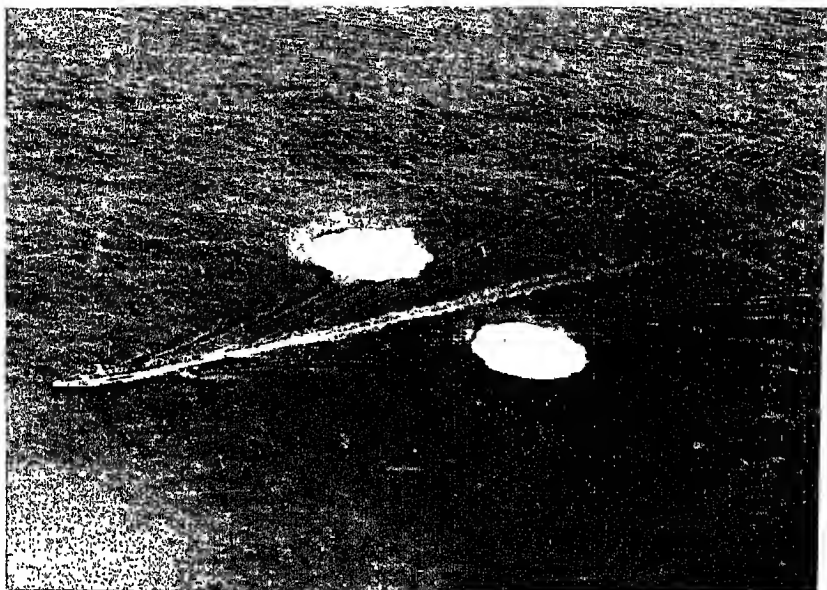
During 1917 our information was that 78 submarines were added and 66 lost, leaving the total at the end of the year at 137.

The losses during 1917, given quarterly, indicate the increasing effectiveness of our anti-submarine measures. These losses, so far as we know them, were :

First quarter	...	10	Third quarter	...	20
Second quarter	...	12	Fourth quarter	...	24

During 1918, according to Admiral Schecr*, 74 submarines were added to the fleet in the period January to October. The losses during this year up to the date of

* "Germany's High Sea Fleet in the World War" (page 335).



Two Depth Charges after Explosion.
(Taken from the Air.)



The Tell-tale Oil Patch.
(Taken from the Air.)

the Armistice totalled 70, excluding those destroyed by the Germans on the evacuation of Bruges and those blown up by them at Pola and Cattaro. Taken quarterly the losses were :

First quarter	...	18	Third quarter	...	21
Second quarter	...	26	Fourth quarter (to date of Armistice)		6

It will be seen from the foregoing figures for 1917 and 1918 that the full result of the anti-submarine measures inaugurated in 1917 and previous years was being felt in the last quarter of 1917, the results for 1918 being very little in advance of those for the previous half-year.

According to our information, as shown by the figures given above, the Germans had completed by October, 1918, a total of 326 submarines of all classes, exclusive of those destroyed by them in November at Bruges, Pola and Cattaro.

Admiral von Capelle informed the Reichstag Committee that a total of 810 was ordered before and during the war. It follows from that statement that over 400 must have been under construction or contemplated at the time of the Armistice.

It is understood that the number of submarines actually building at the end of 1918 was, however, only about 200, which perhaps was the total capacity of the German shipyards at one time.

At the risk of repetition it is as well to repeat here the figures giving the quarterly losses of merchant ships during 1917 and 1918, as they indicate in another and effective way the influence of the anti-submarine measures.

These figures are :

	1917			1918		
	<i>British.</i>	<i>Foreign.</i>	<i>Total.</i>	<i>British.</i>	<i>Foreign.</i>	<i>Total.</i>
1st quarter	911,840	707,533	1,619,373	697,668	445,668	1,143,336
2nd quarter	1,361,870	875,061	2,236,934	630,862	331,145	962,007
3rd quarter	952,938	541,535	1,494,473	512,030	403,483	915,513
4th quarter	782,887	489,954	1,272,843	*83,952	*93,582	*177,534

* Month of October only.

The decline of the losses of British shipping was progressive from the second quarter of 1917; in the third quarter of 1918 the reduction in the tonnage sunk became very marked, and suggested definitely the approaching end of the submarine menace.

The fact that during the second quarter of 1918 the world's output of tonnage overtook the world's losses was another satisfactory feature. The output for 1917 and 1918 is shown in the following table :

	<i>United Kingdom Output.</i>	<i>Dominions, Allied and Neutral Countries.</i>	<i>Total for World.</i>
1917			
1st quarter . .	246,239	340,807	587,046
2nd quarter . .	249,331	435,717	685,048
3rd quarter . .	248,283	426,778	675,061
4th quarter . .	419,621	571,010	990,631
1918			
1st quarter . .	320,280	550,037	870,317
2nd quarter . .	442,966	800,308	1,243,274
3rd quarter . .	411,385	972,735	1,384,130
4th quarter, Oct. only	136,100	375,000	511,100

It will be noticed that by the last quarter of 1918 the output of shipping in the United Kingdom alone had overtaken the losses of British shipping.

It is not possible to give exact information as to the

particular means by which the various German submarines were disposed of, but it is believed that of the 186 vessels mentioned as having been lost by the Germans at least thirty-five fell victims to the depth charge, large orders for which had been placed by the Admiralty in 1917, and it is probably safe to credit mines, of which there was a large and rapidly increasing output throughout 1917, with the same number—thirty-five—a small proportion of these losses being due to the mines in the North Sea Barrage. Our own submarines accounted for some nineteen.

Our destroyers and patrol craft of all natures sank at least twenty by means of gunfire or the ram, and some four or five more by the use of towed sweeps of various natures. Our decoy ships sank about twelve; four German submarines are known to have been sunk by being rammed by men-of-war other than destroyers, four by merchant ships, and about ten by means of our nets. It is fairly certain that at least seven were accounted for by aerial attack. Six were interned, some as the result of injury after action with our vessels.

The total thus accounted for is 156. It was always difficult to obtain exact information of the fate of submarines, particularly in such cases as mine attack, and the figures, therefore, do not cover the whole of the German losses which we estimated at 185.

CHAPTER X

“ PRODUCTION ” AT THE ADMIRALTY DURING 1917

THE anti-submarine measures initiated during the year 1917 and continued throughout the year 1918, as well as those in force in the earlier years of the war, depended very much for their success on the work carried out by the Admiralty Departments responsible for design and production, and apart from this these departments, during the year 1917, carried out a great deal of most valuable work in the direction of improving the efficiency of the material with which the vessels of the Grand Fleet and other warships were equipped.

Early in 1917 certain changes were made in the Naval Ordnance Department. When Captain Dreyer took up the post of Director of Naval Ordnance in succession to Rear-Admiral Morgan Singer on March 1, the opportunity was seized of removing the Torpedo Department, which had hitherto been a branch of the Naval Ordnance Department, from the control of the Director of Naval Ordnance, and Rear-Admiral Fitzherbert was appointed as Director of Torpedoes and Mines, with two assistant Directors under him, one for torpedoes and the other for mines. It had for some time been apparent to me that the torpedo and mining work of the Fleet required a larger and more independent organization, and the intention to adopt a very extensive mining policy accentuated the necessity of appointing a larger staff and according it greater independence. The change also relieved the

D.N.O. of some work and gave him more liberty to concentrate on purely ordnance matters.

Captain Dreyer, from his experience as Flag Captain in the *Iron Duke*, was well aware of the directions in which improvement in armament efficiency was necessary, and a variety of questions were taken up by him with great energy.

Some of the more important items of the valuable work achieved by the Naval Ordnance Department during the year 1917, in addition to the provision of various anti-submarine measures mentioned in Chapter III, were :

(1) The introduction of a new armour-piercing shell of far greater efficiency than that previously in use ; the initial designs for these shells were produced in the drawing office of the Department of the Director of Naval Ordnance.

(2) The introduction of star shell.

(3) The improvement of the arrangements made, after our experience in the Jutland action, for preventing the flash of exploding shell from being communicated to the magazines.

Taking these in order, the *New Armour-piercing Shell* would have produced a very marked effect had a Fleet action been fought in 1918. Twelve thousand of these new pattern shell had been ordered by November, 1917, after a long series of experiments, and a considerable number were in an advanced stage of construction by the end of the year. With our older pattern of shell, as used by the Fleet at Jutland and in earlier actions, there was no chance of the burst of the shell, when fired at battle range, taking place inboard, after penetrating the side armour of modern German capital ships, in such a position that the fragments might

be expected to reach and explode the magazines. A large proportion of the shell burst on the face of the armour, the remainder while passing through it. In the case of the new shell, which was certainly twice as efficient and which would penetrate the armour without breaking up, the fragments would have a very good chance of reaching the magazines of even the latest German ships.

The greatest credit was due to the Ordnance Department and to our enterprising manufacturers for the feat which they achieved. We had pressed for a shell of this nature as the result of our experience during the Jutland action, and it was badly wanted.

We had experienced the need for an efficient *Star Shell* both in the Grand Fleet and in southern waters, and after the Jutland action the attention of the Admiralty had been drawn by me to the efficiency of the German shell of this type. In the early part of 1917, during one of the short night bombardments of the south coast by German destroyers, some German star shell, unexploded, reached the shore. Directions were at once given to copy these shell and not to waste time by trying to improve upon them, a procedure dear to technical minds but fatal when time is of the first importance. Success was soon attained, and star shell were issued during 1917 to all our ships, the vessels of the Dover and Harwich patrol force and the shore battery at the North Foreland being the first supplied.

Important experiments were carried out in 1917 on board H.M.S. *Vengeance* to test the *Anti-flash* arrangements with which the Fleet had been equipped as the result of certain of our ships being blown up in the Jutland action. Valuable information was obtained from these

experiments and the arrangements were improved accordingly.

The work of the Torpedo and Mining Department was also of great value during 1917. The principal task lay in perfecting the new pattern mine and arranging for its production in great numbers, in overcoming the difficulties experienced with the older pattern mines, and in arranging for a greatly increased production of explosives for use in mines, depth charges, etc.

These projects were in hand when the new organization involving the appointment of an Admiralty Controller was adopted.

The circumstances in which this great and far-reaching change in organization was brought about were as follows. In the spring of 1917 proposals were made to the Admiralty by the then Prime Minister that some of the work carried out at that time by the Third Sea Lord should be transferred to a civilian. At first it was understood by us that the idea was to re-institute the office of additional Civil Lord, which office was at the time held by Sir Francis Hopwood (now Lord Southborough), whose services, however, were being utilized by the Foreign Office, and who had for this reason but little time to devote to Admiralty work. To this proposal no objection was raised.

At a later stage, however, it became evident that the proposal was more far reaching and that the underlying idea was to place a civilian in charge of naval material generally and of all shipbuilding, both naval and mercantile. Up to the spring of 1916 mercantile shipbuilding had been carried out under the supervision of the Board of Trade, but when the office of Shipping Controller was instituted this work had been placed under that Minister,

who was assisted by a committee of shipbuilders termed the "Shipbuilding Advisory Committee." Statistics show that good results as regards mercantile ship production were not obtained under either the Board of Trade or the Shipping Controller, one reason being that the supply of labour and material, which were very important factors, was a matter of competition between the claims of the Navy and those of the Mercantile Marine, and another the fact that many men had been withdrawn from the shipyards for service in the Army. There was especial difficulty in providing labour for the manufacture of machinery, and at one time the Admiralty went so far as to lend artificers to assist in the production of engines. The idea of placing the production of ships for both services under one head appealed to and was supported by the Admiralty. The next step was a proposal to the Admiralty that Sir Eric Geddes, at that time the head of the military railway organization in France with the honorary rank of Major-General, should become Admiralty Controller. This would place him in charge of all shipbuilding for both services as well as that portion of the work of the Third Sea Lord which related to armament production. I was requested to see Sir Eric whilst attending a conference in Paris with a view to his being asked to take up the post of Admiralty Controller. This I did after discussing the matter with some of the heads of the War Office Administration and members of General Headquarters in France.

I learned from Sir Eric Geddes that he felt capable of undertaking the work on the understanding that he was assured of my personal support; he said that experience in his railway work in France had shown the difficulty of taking over duties hitherto performed by officers, and stated that it could not have been carried through

without the strong support of the Commander-in-Chief; for this reason he considered he must be assured of my support at the Admiralty. In view of the importance attached to combining under one administration the work of both naval and mercantile shipbuilding for the reasons already stated, and influenced in some degree by the high opinion held of Sir Eric Geddes by the Prime Minister, I came to the conclusion that his appointment would be of benefit to Admiralty work, and therefore gave him the assurance and said that I would do my best to smooth over any difficulties with the existing Admiralty officials, whether naval or technical.

In these circumstances Sir Eric Geddes was offered the post of Admiralty Controller by Sir Edward Carson, then First Lord, and accepted it. It was arranged that a naval officer should continue to hold the post of Third Sea Lord and that he should be jointly responsible, so far as the Navy was concerned, for all *design* work on its technical side, whether for ships, ordnance material, mines, torpedoes, etc., etc., whilst the Controller became entirely responsible for *production*. It was obvious that goodwill and tact would be required to start this new organization, which was decidedly complicated, and that the post of Third Sea Lord would be difficult to fill. At the request of Sir Eric Geddes Rear-Admiral Lionel Halsey, C.B., who at that time was Fourth Sea Lord, was asked if he would become Third Sea Lord in the new organization. He consented and was appointed. When the detailed organization, drawn up to meet the views of Sir E. Geddes, was examined by the naval officers responsible for armament work, strong objections were raised to that part of the organization which affected their responsibility for the control and approval of designs and of inspection.

Sir Eric held the view that inspection should come

under the officials in charge of production and that the designing staff should also be under him, the designs being drawn up to meet the views of the naval officers and finally approved by them. Personally I saw no *danger* in the proposals regarding design, because the responsibility of the naval officer for final approval was recognized; but there was a certain possibility of delay if the naval technical officer lost control over the designing staff. I fully agreed with the criticisms on the subject of inspection, the argument being that only naval officers accustomed to *use* the ordnance material could know the dangers that might arise from faulty inspection, and that the producer had temptations in his path, especially under war conditions, to make inspection subservient to rapidity of production. Sir Eric Geddes finally waived his objections. He informed me that he based his arguments largely on his experience at the Ministry of Munitions, with which he had been associated earlier in the war. The contention of the naval officers at the Admiralty was that even if the organization proposed was found to be workable for the Army, it would not be satisfactory for the Navy, as in our case it was essential that the responsibility for approval of design and for inspection should be independent of the producer, whether the producer was a Government official or a contractor. Apart from questions of general principle in this matter, accidents to ordnance material in the Navy, or the production of inferior ammunition, may involve, and have involved, the most serious results, even the complete loss of battleships with their crews, as the result of a magazine explosion or the bursting of a heavy gun. I could not find that the organization at the Ministry of Munitions had, even in its early days, placed design, inspection and production under one head; inspection and design had

each its own head and were separate from production. In any case in 1918 the Ministry of Munitions reverted to the Admiralty system of placing the responsibility for design and inspection under an artillery expert who was neither a manufacturer nor responsible for production.

The matters referred to above may appear unimportant to the civilian reader, but any question relating to the efficiency of its material is of such paramount importance to the fighting efficiency of the Navy that it is necessary to mention it with a view to the avoidance of future mistakes.

The new organization resulted in the creation of a very large administrative staff for the purpose of accelerating the production of ships, ordnance material, mines, etc. Indeed, the increase in numbers was so great that it became necessary to find additional housing room, and the offices of the Board of Education were taken over for the purpose. The personnel of that portion of the Admiralty dealing with design, inspection and production at different dates, as well as the Staff organization, is given in the appendices. It was felt that the increase in staff, though it involved, of course, very heavy expenditure, would be justified if it resulted in increased rapidity of production. It will be readily understood that such an immense change in organization, one which I had promised to see through personally, and which was naturally much disliked by all the Admiralty departments, threw a vast volume of extra work on my shoulders, work which had no connexion with the operations of war, and this too at a period when the enemy's submarine campaign was at its height. I should not have undertaken it but for the hope that the change would result in greatly increased production, particularly of warships and merchant ships.

The success of this new organization can only be measured by the results obtained, and by this standard, if it were possible to eliminate some of the varying and incalculable factors, we should be able to judge the extent to which the change was justified. It was a change for which, under pressure, I bore a large share of responsibility, and it involved replacing, in the middle of a great war, an organization built up by experts well acquainted with naval needs by one in which a considerable proportion of the personnel had no previous experience of the work. The change was, of course, an experiment; the danger lay in the fact that, until technical and Admiralty experience has been gained, even men of the greatest ability in other walks of life may find it difficult to produce satisfactory results even if there are no limits imposed on the size of the Staff which assists them.

The question of production is best examined under various headings and the results under the old Admiralty organization compared with those under the new, although comparison is admittedly difficult owing to changing conditions.

Warship Production

Under the Admiralty organization existing up to May, 1917, the Third Sea Lord—as the Controller was termed when changes were introduced by Mr. Churchill in 1912—was head of the Departments of the Director of Naval Construction and Engineer in Chief, and of that part of the work of the Director of Naval Ordnance which dealt with the design and production of guns and gun mountings. Under the new organization a civilian Controller became responsible for production, the Third Sea Lord being associated with him on technical matters of design.

A special department for warship production and

repairs was set up under a Deputy Controller, the Third Sea Lord having no authority over this department except by his association with the Controller.

Under the old organization it had been the custom during the war for the Third Sea Lord to give to the Board and to the Commander-in-Chief of the Grand Fleet a personal forecast of the anticipated dates of completion of all warships under construction. My experience whilst in command of the Grand Fleet had been that this personal forecast was generally fairly accurate for six months ahead.

As an example it may be stated that in the first four months of 1917 the delivery of destroyers *was within one of the forecast* made in October, 1916, four vessels of the class being slightly behind and three ahead of the forecast. Of thirteen “E” class submarines forecasted in October, 1916, for delivery by March, 1917, all except two were delivered by April; of twelve “K” class submarines forecasted for delivery in the same period, all except three were delivered by April, 1917. It should be stated that these “K” class submarines were vessels of a new type, involving new problems of some difficulty.

On the other hand there was considerable delay in the completion of a number of the thirty “P” boats forecasted in October, 1916, for delivery during the first seven months of 1917, and the April forecast showed that only twenty out of the thirty would be delivered during that period. There was also some delay in the delivery of twin screw minesweepers, twenty of which were shown in the forecast of October, 1916, as due for delivery in the first six months of 1917. The April, 1917, forecast showed that six had been delivered or would complete in April, ten more would complete within the estimated period, and the four remaining would be

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overdue and would not be delivered until July or August.

These figures show the degree of reliance which could be placed on the personal forecasts of the Third Sea Lord under the old organization. It is, of course, a fact that accurate forecasts do not *necessarily* mean that the rate of production is satisfactory, but only that the forecast is to be depended on. We were never at all satisfied with the rate of production, either under the old or the new organization. Accuracy of forecast was, however, of great use from the Staff point of view in allotting new ships to the various commands and in planning operations.

To turn now to the figures given by the Admiralty Controller under the new organization. The table below shows the forecasts ("F") given in June, 1917, and the deliveries ("D") of different classes of warships month by month during the period of July to November of that year :

Class of Vessel.	July.		Aug.		Sept.		Oct.		Nov.		Deficit in 5 months.
	F	D	F	D	F	D	F	D	F	D	
Flotilla Leaders and T.B.D's.	5	2	7	8	8	5	5	5	6	6	4
Submarines .	2	0	4	4	5	1	3	3	6	1	11
Sloops .	3	2	5	2	4	2	3	1	3	7	5
"P." Boats .	6	5	6	5	3	3	3	2	1	1	3

Amongst vessels which were classed as auxiliaries the figures were :

Class of Vessel.	July.		Aug.		Sept.		Oct.		Nov.		Deficit in 5 months.
	F	D	F	D	F	D	F	D	F	D	
Minesweepers .	5	3	4	4	3	1	3	2	2	0	7
Trawlers .	25	18	23	14	30	13	27	28	33	24	41

It will be seen from these figures that the forecast of June was inaccurate even for the three succeeding

months, and that the total deficit in the five months was considerable, except in the case of T.B.D.'s and “P” boats.

The most disappointing figures were those relating to submarines, trawlers and minesweepers. The case of the submarines may be put in another way, thus :

In the June forecast twenty-six submarines were forecasted for delivery during the period July to the end of December, the dates of three, however, being somewhat uncertain; of this total of twenty-six, *only nine were actually delivered*. Of the remainder, seven were shown in a November forecast as delayed for four months, two for five months, and one for nine months.

The attention of the Production Departments was continually directed to the very serious effect which the delay was producing on our anti-submarine measures, and the First Lord, Sir Eric Geddes, was informed of the difficult position which was arising. In the early part of December I pointed out to the Third Sea Lord and the Admiralty Controller, Sir Allan Anderson, that it was obviously impossible for the Naval Staff to frame future policy unless some dependence could be placed on the forecast of deliveries. The Controller in reply stated that accurate forecasts were most difficult, and proposed a discussion with the Third Sea Lord and myself, but I had left the Admiralty before the discussion took place.

The delays, as will be seen from the tables given, were most serious in the case of vessels classed as auxiliaries. Sir Thomas Bell, who possessed great experience of shipbuilding in a private capacity, was at the head of the Department of the Deputy Controller for Dockyards and Shipbuilding, and the Director of Warship Production was a distinguished Naval constructor.

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The Deputy Controller of Auxiliary Shipbuilding was an officer lent from the War Office, whose previous experience had lain, I believe, largely in the railway world; some of his assistants and staff were, however, men with experience of shipbuilding.

When I became First Sea Lord at the end of 1916 the new building programme, which had received the sanction of the Cabinet, was as follows :

8 Flotilla leaders.	500 Trawlers.
65 'T.B.D.'s.	60 Submarines.
34 Sloops.	4 Seaplane carriers.
48 Screw minesweepers.	60 Boom defence vessels.
16 Paddle ,,	

During the early part of 1917 it was decided to substitute 56 screw minesweepers and 8 paddle sweepers for the approved programme of this class of vessel and to add another 50 screw minesweepers to meet the growing mine menace, as well as to substitute 115 drifters for 50 of the trawlers, and to request the Canadian Government to build 36 trawlers and 100 drifters mainly for use in Canadian waters. It was also decided to lay down 36 mercantile decoy ships and 12 tugs, and to build 56 motor skimmers on the lines of the coastal motor boats, which were then showing their value off the Belgian coast. The programme therefore, in May, 1917, was as follows :

Flotilla leaders	...	...	...	...	...	8
T.B.D.'s	...	...	...	...	...	65
Patrol boats	...	...	...	...	...	6
Sloops	...	...	...	...	...	34
Minesweepers (screw)	...	...	...	...	...	56
,, (paddle)	8
Additional twin-screw minesweepers	50

“Production” during 1917

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Submarines	60
Trawlers	450
Drifters	115
Canadian trawlers	36
„ drifters	100
Boom defence vessels	...	...	...	...	...	60
Mercantile decoy ships...	...	...	...	...	...	36
Seaplane carriers	...	...	...	...	...	4
Tugs	...	...	...	...	...	12
Motor skimmers	...	...	...	...	...	56

Meanwhile intelligence had been received which indicated that Germany was building such a considerable number of light cruisers as to jeopardize our supremacy in this class of vessel, and it was decided by the Board that we ought to build eight more light cruisers even at the cost of appropriating the steel intended for the construction of six merchant ships.

Further, the German submarine programme was developing with great rapidity, and our own submarines of the “L” class were taking a very long time to build. It was therefore proposed to substitute eighteen additional “H” class submarines for four of the “L” class, as the vessels of the “H” class were capable of more rapid construction, thus making the total number of submarines on order 74. Approval was also sought for the addition of 24 destroyers and four “P” boats to the programme, bringing the number of destroyers on order up to a total of 89.

The programme was approved, a slight change being made in the matter of the seaplane carriers by fitting out one of the “Raleigh” class of cruisers as a seaplane vessel in order to obtain an increased number of vessels of this type more rapidly than by building. Later in the

year the cruiser *Furious* was also converted into a sea-plane carrier, and she carried out much useful work in 1918.

Mercantile Shipbuilding

A greatly increased output of merchant ships had been anticipated under the new organization, which placed mercantile construction under the Admiralty Controller instead of under the Ministry of Shipping. It was expected that the difficulties due, under the previous arrangement, to competing claims for steel and labour would vanish with very beneficial results.

It was, as previously stated, mainly with this object that the Admiralty had agreed to the change. The start was promising enough. After a review of the situation hopes were held out that during the second half of 1917 an addition of about 1,000,000 tons of shipping from the shipyards within the United Kingdom would be effected. This figure, indeed, was given to the House of Commons by the Prime Minister on August 16, 1917.

On comparing this figure with that of the first half of the year (a total of about 484,000 tons) there was distinct cause for gratification; it is right to state that Admiralty officials who had previously been watching mercantile shipbuilding regarded the estimate as very optimistic. Further, it was anticipated by the then Admiralty Controller, Sir Eric Geddes, that during the year 1918, with some addition to the labour strength, a total output of nearly two million tons was possible, provided steel was forthcoming, whilst with considerably greater additions to the labour strength and to the supply of steel, and with the help of the National Shipyards proposed by the Controller, the total output might even reach three million tons.

The actual results fell very short of these forecasts.

“Production” during 1917

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The total output for the second half of the year was only 620,000 tons, the monthly totals in gross tonnage for the whole year being :

January	...	46,929	July	...	...	81,188
February	...	78,436	August	...	...	100,900
March	...	115,654	September	...	...	60,685
April	...	67,586	October	...	...	145,844
May	...	68,083	November	...	...	158,826
June	...	108,397	December	...	...	112,486

In January, 1918, the total dropped to 58,568 tons, and in February was only 100,088 tons. In March it was announced that Lord Pirie would take the position of Controller General of Merchant Shipbuilding. The subsequent results in the direction of output of merchant ships do not properly come within the scope of this book, which is intended to deal only with work during the year 1917, but it may be of interest to give here the output month by month. It was as follows :

January	...	58,568	July	...	...	141,948
February	...	100,088	August	...	...	124,675
March	...	161,674	September	...	...	144,772
April	...	111,533	October	...	...	136,000
May	...	197,274	November	...	...	105,098
June	...	134,159	December	...	...	118,276
		Total for the year	...	...	...	1,584,110

It will be seen that the results for 1918 were an improvement on those for 1917, the exact figure for that year being 1,168,474 tons; these results, however, fell very short of the optimistic estimates given in July, 1917.

Mercantile Repair Work

The Controller's Department undoubtedly succeeded in the work of improving the arrangements for the repair

of merchant ships. This is shown by an analysis of the total number of vessels that *completed* repairs during various months.

In August, 1917, the number was 382, with a tonnage of 1,183,000. In November the figure became 542 ships, with a tonnage of 1,509,000. There remained under repair at the end of August 326 ships, and at the end of November 350 ships, these figures indicating that the greater number of completions was not due to the smaller number of vessels being damaged or the damages being less in extent.

Considerable credit is due to the Department for this successful acceleration of repair work which naturally had a great influence on the shipping situation.

Armament Production

It was not, I think, realized either by the Government or by the civilians brought into the Admiralty during the year 1917 that there was a very great difference between the Admiralty and the War Office organizations in the matter of production of material, nor was it recognized that naval officers are by their training and experience better fitted to deal with such matters on a large scale than are military officers, except perhaps officers in the Artillery and Royal Engineers. Whatever may be the case in the future, the Navy in pre-war days was so much more dependent on material than the Army as to make questions relating to naval material of far greater importance than was the case with military material. This fact is apt to be forgotten by those writers on naval affairs who think that an intimate knowledge of questions relating to naval material *and its use* is of little importance. I trust that this belief will never become general in the service, for the naval officer who is not familiar with the

design and production of material is handicapped when he comes to use it.

Ignorance of the great experience of the Admiralty in handling problems of production and of the past success of Admiralty methods in this respect gave rise to a good deal of misconception. The fact that it had been necessary to form a separate Ministry (that of Munitions) to deal with the production of war material for the Army probably fostered the idea that matters at the Admiralty should be altered in a similar direction.

The post of Deputy Controller of Armament Production was created under the new organization, and all matters concerning the production of guns, gun-mountings, projectiles, cordite, torpedoes, mines, paravanes and all other war material was placed under him. I have dealt earlier in this chapter with the questions of design and inspection over which some disagreement arose.

I was not conscious that the new organization succeeded in speeding up armament production during 1917, and during the latter part of the year I was much concerned with the delays in ordnance production as revealed during 1917 and as exposed by the forecasts for 1918.

It is very possible, on the other hand, that in the case of mines the results were good. The old Admiralty organization had not been equipped to deal with such an immense number of mines as were on order, and although a large organization for their production was started by Sir Lionel Halsey, when Fourth Sea Lord, with the assistance of Admiral Fitzherbert and Captain Litchfield-Speer, it had not been sufficiently long at work for an opinion to be given as to whether the results in production would have been as good as under the D.C.A.P.

In considering the whole question of production during the year 1917 it should be borne in mind that very extensive orders were placed in the early part of that year for guns, gun-mountings, mines, warships of the smaller class and patrol craft, and that if we compare only the actual output for 1917 with that of previous years without taking the above fact into account, we might form an incorrect impression as to the success of the organization for production. For instance, in the last quarter of 1917, 1,515 guns of all calibres were delivered, as against 1,101 in the first quarter; in the month of November 1,335 mines of all natures and 2,078 depth charges were filled, as compared with 625 mines and 542 depth charges in July. These figures were the result of the large orders placed early in the year, and it was not until 1918 that the full fruits of the orders placed in 1917 became apparent. The figures for that year, however, are not at my disposal.

One great advantage which resulted from the new organization, viz., the creation of a Directorate of Materials and Priority, must be mentioned. This Directorate controlled the distribution of all steel for all services and produced a very beneficial effect on the issue of supplies of steel to shipbuilders. The growth of the Admiralty Organization for Production at different stages is shown in the appendices. The immense increase in staff which resulted from the institution of the office of Admiralty Controller is exhibited in the lists of staff in 1918 as compared with the staff in the early part of 1917.

CHAPTER XI

NAVAL WORK

THE main effort of the Navy during the year 1917 was directed towards the defeat of the enemy's submarines, since the Central Powers confined their naval effort almost entirely to this form of warfare, but many other problems occupied our attention at the Admiralty, and some of these may be mentioned.

Considerable discussion took place in the early part of the year on the subject of the policy to be pursued in the Eastern theatre of war, and naval opinion on the possibility of effecting a landing in force at different points was invited and given. It need only be said here that the matter was brought forward more than once, and that the situation from the naval point of view was always clear. The feasible landing places so far as we were concerned were unsuited to the military strategy at that period; the time required to collect or build the great number of lighters, horse boats, etc., for the strong force required was not available, and it was a sheer impossibility to provide in a short period all the small craft needed for an operation of magnitude, whilst the provision of the necessary anti-submarine defences would have taxed our resources to the utmost and have prevented essential work of this nature in other theatres.

The work of the Navy, therefore, *off the coast of Palestine* was confined to protecting the left flank of the advancing army and assisting its operations, and to

establishing, as the troops advanced, bases on the coast at which stores, etc., could be landed. This task was effectively carried out.

The anchorages on this coast are all entirely open to the sea, and become untenable at very short notice, so that the work of the Navy was always carried out under considerable difficulty. Nor could the ships working on the flank be adequately guarded against submarine attack, and some losses were experienced, the most important being the sinking of Monitor M15 and the destroyer *Staunch* by a submarine attack off Deir el Belah (nine miles south of Gaza) in November.

The Navy continued its co-operation with the Army in the *Salonika theatre of war*, assisted by the Royal Naval Air Service, and bombardments were continually carried out on military objectives. Similarly in the *Adriatic* our monitors and machines of the R.N.A.S. assisted the military forces of the Allies; particularly was this the case at the time of the Austrian advance to the Piave, where our monitors did much useful work in checking enemy attempts to cross that river.

Off the Gallipoli Peninsula the Naval watch on the mouth of the Dardanelles was continued; extensive new minefields were laid during the year, and were effective in sinking the *Breslau* and severely damaging the *Goeben* when those vessels attempted a sortie on January 20, 1918. The R.N.A.S. during the year carried out many long distance reconnaissance and bombing operations over Constantinople and the vicinity.

In the Red Sea Naval operations were carried out in conjunction with friendly Arabs, and the Arabian coast cleared of Turkish forces.

In the White Sea during the latter part of 1917 the whole of the Naval work fell upon British Naval forces

when the Russian ships, which had co-operated hitherto, had come under the influence of the political situation. Our force in these waters consisted largely of trawlers engaged in minesweeping and escort work. The latter duty imposed a very heavy strain on officers and men, involving as it did the safe conduct during the year of no fewer than one thousand ships carrying stores and munitions for the Russian military forces.

In the Baltic the situation became very difficult owing first to the Russian revolution and, finally, to the Russian debacle. Our force in these waters consisted of seven submarines. It became evident at the beginning of October, 1917, that the Germans were intending to carry out some operations in the Baltic against Russia, and the question of affording assistance was at once considered by the Naval Staff. It was surmised that but little dependence could be placed on the Russian Baltic Fleet (events showed this surmise to be accurate), and in order to keep our control over the North Sea and ensure the safety of our communications with France it was obvious that for any action we might decide to take we should be obliged to divide the Grand Fleet, sending such portion of that Command into the Baltic as could successfully engage the High Sea Fleet if encountered, as well as to secure the return passage via the Great Belt, and retaining a sufficient force to deal with such German vessels as might attempt operations in the North Sea or Channel during our raid into the Baltic.

There were many ways in which the Germans might seriously hamper, if not entirely prevent, the return of our fleet from the Baltic unless we secured the exits. The Great Belt could easily be closed by block-ships at its narrowest points, and extensive minefields could be laid. It was obvious, therefore, that to secure the exit

a strong force would be required, and that it would necessarily occupy a position where it would be open to serious attack.

The initial operation of gaining access to the Baltic via the Great Belt, though not impossible, was difficult, involving as it did sweeping passages through very extensive minefields, and even when our ships were in the Baltic fairly constant sweeping would be necessary.

Finally, the whole operation would be complicated by the question of fuel supply, especially to the destroyers and other small craft with a limited radius of action, since we could not depend upon Russian sources of supply. These were amongst the considerations which made it clear that the operation was not one that I could recommend. The Russian naval view is given in the following statement which appeared in the Russian Press in October :

[The Naval General Staff categorically denies the rumours circulated in Petrograd on the 8th and 9th instant, to the effect that the British or French Fleet had broken through to the Baltic Sea.

At the same time it is pointed out that it would be a physical impossibility for the Allies' Fleet to come in from the western entrance, because it would be necessary to pass through the Sound or through one of the two Belts.

Entry to the Sound through Danish or Swedish waters could not also be affected owing to the fact that these waters in part are only 18 feet deep, while large-sized vessels would require at least 30 feet of water.

As regards the entry to the Belts, this would be an extremely hazardous undertaking as parts of the routes are under control of the Germans who have constructed their own defences consisting of mines and batteries.

In these circumstances, according to the opinion of our naval experts, an entrance into the Baltic by the Allies'

Fleets could only be undertaken after gaining possession of these waters and the adjacent coast; and then only with the co-operation of land forces.

The Germans had an easy task in the Baltic, as the Russian resistance was not of a serious nature; our submarines attacked on every possible occasion, and scored some successes against German vessels. Towards the end of the year it became necessary to consider the action to be taken in regard to our submarines, as the German control of the Baltic became effective, and the demobilization of the Russian fleet became more and more pronounced. Many schemes for securing their escape from these waters were discussed, but the chances of success were so small, and the submarines themselves possessed so little fighting value owing to their age, that eventually instructions were sent to the senior officer to destroy the submarines before they could fall into German hands.

CHAPTER XII

THE FUTURE

It is natural that the task of recounting the facts in the foregoing chapters should cause one's thoughts to turn to the future. The Empire has passed through a period of great danger, during which its every interest was threatened, and it has come successfully out of the ordeal, but to those upon whom the responsibility lay of initiating and directing the nation's policy the serious nature of the perils which faced us were frequently such as to justify the grave anxiety which sprang from full knowledge of events and their significance.

An international organization is in process of being brought into existence which, if it does not entirely prevent a recurrence of the horrors of the four and a half years of war, will, it is hoped, at least minimize the chances of the repetition of such an experience as that through which the world has so recently passed. But the League of Nations is still only a skeleton to be clothed with authority and supported by the public opinion of the world if it is to be a success. It is in its infancy, and so far the most optimistic have not advanced beyond hopes in its efficiency; and if the lessons of the past are correctly interpreted, as they were interpreted by our forefathers in their day, those upon whom responsibility lies in future years for the safety and prosperity of the Empire will see to it that, so far as lies in their power, whatever else may be left undone, the security of the

sea communications of the Empire is ensured. Not one of us but must have realized during the war, if he did not realize it before, that the all-important thing upon which we must set our minds is the ability to use the sea communications of the far-flung Empire, which is only united by the seas so long as we can use them. But while governments may realize their duty in this matter, and set out with good intentions, it is, after all, upon the people who elect governments that the final responsibility lies, and therefore it is to them that it is so necessary to bring home in season and out of season the dangers that confront us if our sea communications are imperilled.

The danger which confronted the British peoples was never so great in any previous period as it was during the year 1917 when the submarine menace was at its height, and it may be hoped that the lessons to be learned from the history of those months will never be forgotten. The British Empire differs from any other nation or empire which has ever existed. Our sea communications are our very life-blood, and it is not greatly exaggerating the case to say that the safety of those communications is the one consideration of first-class importance. Upon a solid sense of their security depends not only our prosperity, but also the actual lives of a large proportion of the inhabitants. There is no other nation in the world which is situated as the people of these islands are situated; therefore there is no other nation to whom sea power is in the least degree as essential as it is to us. Four out of five of our loaves and most of our raw materials for manufacture must come to us by sea, and it is only by the sea that we can hold any commercial intercourse with the Dominions, Dependencies and Crown Colonies, which together make up what we call the Empire, with a population of 400,000,000 people.

What, then, are we to do in the future to ensure the safety of the communications between these islands and the rest of the Empire? As a matter of course we should be in a position to safeguard them against any possible form of attack from whatever quarter it may come. So far as can be seen there is no present likelihood of the transport of food or raw materials being effected in anything but vessels which move upon the surface of the sea. It is true that, as a result of the war, people's thoughts turn in the direction of transport, both of human beings and of merchandise, by air or under the water, but there is no possible chance, for at least a generation to come, of either of these methods of transport being able to compete commercially with transport in vessels sailing on the sea. Therefore the problem of guarding our communications resolves itself into one of securing the safety of vessels which move upon the surface of the sea, whatever may be the character of the attack.

I do not desire to enter into any discussion here as to the method by which these vessels can be protected, except to say that it is necessary for us to be in a position of superiority in all the weapons by which their safety may be endangered. At the present time there are two principal forms of attack: (1) by vessels which move on the surface, and (2) by vessels which move under water. A third danger—namely, one from the air—is also becoming of increasing importance. The war has shown us how to ensure safety against the first two forms of attack, and our duty as members of a great maritime Empire is to take steps to maintain effective forces for the purpose.

In order to carry out this duty it will be greatly to our advantage if the matter can be dealt with by all the constituent parts of the Empire. A recent tour of the

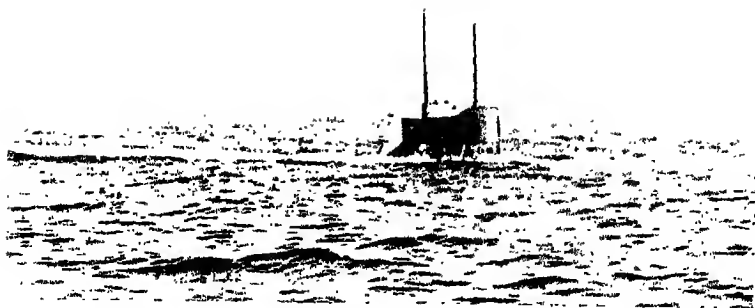
greater part of the British Empire has shown me that the importance of sea power is very fully realized by the great majority of our kith and kin overseas, and that there is a strong desire on their part to co-operate in what is, after all, the concern of the whole Empire. It seems to me of the greatest possible importance that this matter of an Empire naval policy and an Empire naval organization should be settled at the earliest possible moment, and that it should be looked at from the broadest point of view.

I do not think that we in this country can claim to have taken into sufficient account the very natural views and the very natural ambitions which animate the peoples overseas. We have, in point of fact, looked at the whole question too locally, whilst we have been suggesting to the Dominions that they are inclined to make this error, and unless we depart from that attitude there is a possibility that we shall not reap the full benefit of the resources of the Empire, which are very great and are increasing. In war it is not only the material which counts, but the spirit of a people, and we must enlist the support, spontaneous and effective, of every section of the King's Dominions in the task of sea defence which lies before us, consulting fully and unreservedly the representatives of our kith and kin, and giving them the benefit of whatever instructed advice we, with ancient traditions and matured knowledge, may possess.

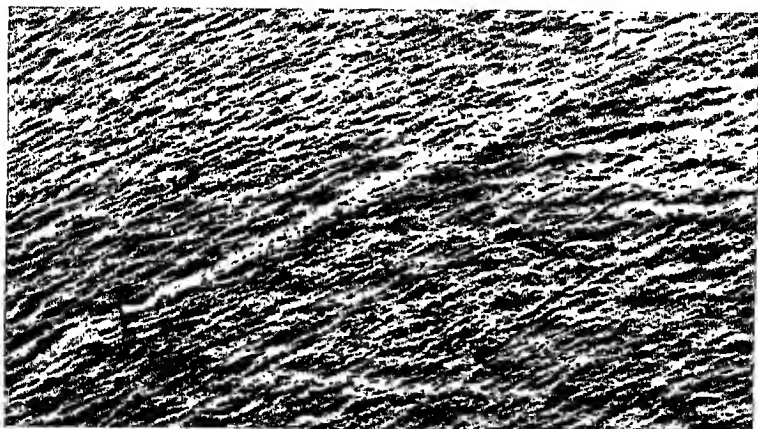
In framing our future naval policy it is obvious that we must be guided by what is being done abroad. We are bound to keep an absolutely safe margin of naval strength, and that margin must exist in all arms and in all classes of vessels. At the moment, and no doubt for some time to come, difficulties in regard to finance will

exist, but it would seem to be nothing more than common sense to insist that the one service which is vital to our existence should be absolutely the last to suffer for need of money. During a period of the greatest financial pressure it may be necessary to economize somewhat in the construction of new ships, and in the upkeep of certain of our naval bases which the result of the war and consequent considerations of future strategy may suggest to be not of immediate importance, although even here it may well be necessary to develop other naval bases to meet changed conditions; but we cannot afford to fall behind in organization, in the testing and development of new ideas, or in the strength of our personnel or in its training. A well trained personnel and a carefully thought out organization cannot by any possibility be quickly extemporized.

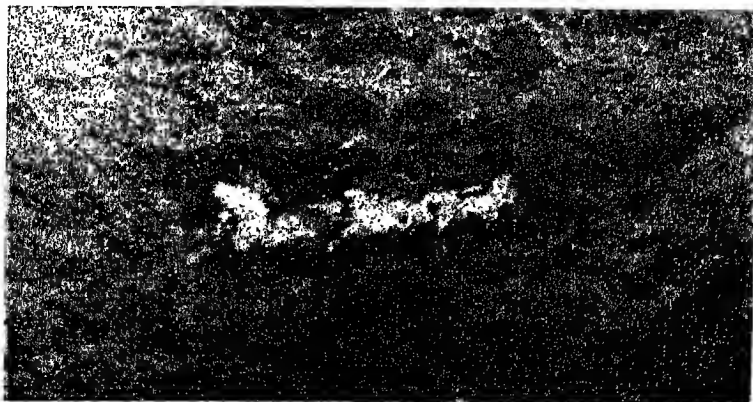
It is the height of economic folly to stint experimental research, for it is in times of stress that the value of past experimental work is shown. In the matter of organization we must be certain that adequate means are taken to ensure that the different arms which must co-operate in war are trained to work together under peace conditions. A modern fleet consists of many units of different types—battleships, battle-cruisers, light cruisers, destroyers and submarines. Before I relinquished the command of the Grand Fleet, large sea-going submarines of high speed, vessels of the "K" class, had been built to accompany the surface vessels to sea. It is very essential that senior officers should have every opportunity of studying tactical schemes in which various classes of ships and kinds of weapons are employed. In considering the future of the Navy it is impossible to ignore aircraft. There are many important problems which the Navy and the Air Service ought to work out together. A



A Submarine Submerging.



Periscope of Submerged Submarine Travelling at Slow Speed.



A Submarine Submerged.
(Taken from the Air.)

fleet without aircraft will be a fleet without eyes, and aircraft will, moreover, be necessary, not only for reconnaissance work, but for gun-spotting, as well as, possibly, for submarine hunting. Air power is regarded by many officers of wide practical experience as an essential complement to sea power, whatever future the airship and aeroplane may have for independent action. A captain who is going to fight his ship successfully must have practised in time of peace with all the weapons he will employ in action, and he must have absolute control over all the elements constituting the fighting power of his ship. In a larger sense, the same may be said of an admiral in command of a fleet; divided control may mean disaster. The advent of aircraft has introduced new and, at present, only partially explored problems into naval warfare, and officers commanding naval forces will require frequent opportunities of studying them. They must be worked out with naval vessels and aircraft acting in close association. With the Air Service under separate control, financially as well as in an executive and administrative sense, is it certain that the Admiralty will be able to obtain machines and personnel in the necessary numbers to carry out all the experimental and training work that is essential for efficiency in action? Is it also beyond doubt that unity of command at sea, which is essential to victory, will be preserved? In view of all the possibilities which the future holds now that the airship and aeroplane have arrived, it is well that there should be no doubt on such matters, for inefficiency might in conceivable circumstances spell defeat.

Then there is the question of the personnel of the fleet. It would be most unwise to allow the strength of the trained personnel of the Navy to fall below the limit of reasonable safety, because it is upon that trained

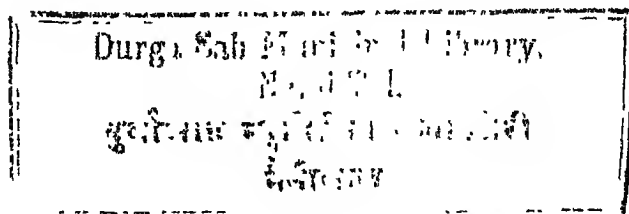
personnel that the success of the enormous expansions needed in war so largely depends. This was found during the late struggle, when the personnel was expanded from 150,000 to upwards of 400,000, throwing upon the pre-war nucleus a heavy responsibility in training, equipment and organizing. Without the backbone of a highly trained personnel of sufficient strength, developments in time of sudden emergency cannot possibly be effected. In the late war we suffered in this respect, and we should not forget the lesson.

In future wars, if any such should occur, trained personnel will be of even greater importance than it was in the Great War, because the advance of science increases constantly the importance of the highly trained individual, and if nothing else is certain it can surely be predicted that science will play an increasing part in warfare in the future. Only those officers and men who served afloat in the years immediately preceding the opening of hostilities know how great the struggle was to gain that high pitch of efficiency which the Navy had reached at the outbreak of war, and it was the devotion to duty of our magnificent pre-war personnel that went far to ensure our victory. It is essential that the Navy of the future should not be given a yet harder task than fell to the Navy of the past as a result of a policy of starving the personnel.

There is, perhaps, just one other point upon which I might touch in conclusion. I would venture to suggest to my countrymen that there should be a full realization of the fact that the Naval Service as a whole is a highly specialized profession. It is one in which the senior officers have passed the whole of their lives, and during their best years their thoughts are turned constantly in one direction—namely, how they can best fit the Navy and

themselves for possible war. The country as a whole has probably but little idea of the great amount of technical knowledge that is demanded of the naval officer in these days. He must possess this knowledge in addition to the lessons derived from his study of war, and the naval officer is learning from the day that he enters the Service until the day that he leaves it.

The Navy, then, is a profession which is at least as highly specialized as that of a surgeon, an engineer, or a lawyer. Consequently, it would seem a matter of common sense that those who have not adopted the Navy as a profession should pay as much respect to the professional judgment of the naval officer as they would to that of the surgeon or the engineer or the lawyer, each in his own sphere. Governments are, of course, bound to be responsible for the policy of the country, and policy governs defence, but, both in peace and in war, I think it will be agreed that the work of governments in naval affairs should end at policy, and that the remainder should be left to the expert. That is the basis of real economy in association with efficiency, and victory in war goes to the nation which, under stress and strain, develops the highest efficiency in action.



APPENDICES

Appendices

FREQUENT references have been made in this volume to the organization and development of the staff at the Admiralty, on whom the duty devolved of initiating and directing naval operations, both those concerned with the war on the surface and those connected with the mining and submarine campaigns conducted by the enemy. It has been thought that it will tend to render the references to staff organization more intelligible if complete statements are appended of (a) the Staff as it existed towards the end of October, 1916, (b) after the reorganization which took place in the early months of 1917, (c) as it existed towards the end of December, 1917, and (d) as it was towards the end of November, 1918. Similarly the Staff of the Admiralty Departments engaged in the work of Design, Inspection and Production is also shown.

It may be suggested also that these lists have a personal interest to the large number of officers of the Royal Navy and Royal Marine, as well as to the civilians, who rendered conspicuous service to the country at the Admiralty during the last two years of the war. The lists may also prove useful in future years when the staff organization of the Admiralty is discussed in the light of new conditions.

The lists do not include members of the Board of Admiralty other than those on the "Operations" side, or many Admiralty Departments not engaged in Staff work or in the "Matériel" Departments.

(a) ADMIRALTY, END OF OCTOBER, 1916.

First Sea Lord.....Admiral Sir Henry Jackson, K.C.B.

ADMIRALTY WAR STAFF.

Chief of the War Staff.....Vice-Admiral (act.) Sir Henry F. Oliver, K.C.B., M.V.O.

Assistant to the Chief of the War Staff.....Captain Arthur de K. T. May.

Staff Clerk.....W. H. Hancock, Esq. (act.)

OPERATIONS DIVISION.

Director of the Operations Division.....Rear Admiral Thomas Jackson, C.B., M.V.O.

Assistant Directors of the Operations Division.....Captain Henry W. Grant.

Lieut.-Col. Walter T. C. Jones, D.S.O., R.N.L.I.

Naval and Marine Staff.

Captain.....A. G. Allgood (ret.).

A. M. Beal.

R. P. Clutton (ret.).

C. H. S. Eeles (ret.).

W. M. Kerr.

C. Seymour.

H. J. L. W. K. Willcox.

Charles D. Roper (temp.).

Commander Raymond Fitzmaurice, D.S.O.

Frederic G. S. Falle.

Charles G. Dix, D.S.O.

F. Bowden-Smith (ret.).

G. V. Brooko-Welsh (ret.).

S. V. S. C. Messum (ret.).

T. W. Skirling (emery.).

Leonard Robinson (act.).

Maj. & Lt. Col.

Fitzstephon J. F. French.

Lieut.-Com. J. P. Gibbs.

Civil Staff.

Staff Clerk.....G. J. Rickman, Esq.

2 Second Division Clerks.

1 Confidential Shorthand Writer.

11 Assistant Clerks.

2 Accountant Clerks.

3 Extra Clerks.

INTELLIGENCE DIVISION.

Director of the Intelligence Division.....Captain William R. Hall, C.B., ADC.

Assistant Directors of the Intelligence Division..... Captain Raymond A. Nugent (temp.).

Captain Thomas B. Wardle, D.S.O.

Naval and Marine Staff.

Captain ... Herbert W. W. Hope.

Commander Vivian R. Brandon.

Francis G. G. Clifton.

Colpoys G. Walcott

(ret.).

Lewis D. Poulford

(ret.).

Ernest F. Gregory.

Gerald G. Dickens.

Commander } Henry F. C. Caven-

(emery.) } dish.

Commander } Lord Herschell,

R.N.V.R. } M.V.O.

Hon. William

Ozerns-Hardy, K.C.

Lieut.-Com. Walter T. Bagot.

James P. Houston.

Arthur W. Wood (ret.).

Lieut.Roger V. de la Harpe

(ret.) (temp.).

Eng. Com....Forcy Wheatlar.

MajorFrank V. Temple.

R.N.L.I.

Walter Sholeir.

R.N.L.I.

Captain ...Percy R. Hancock.

R.N.A.

Ocell E. S. Wright.

R.N.L.I.

Bernard F. Trench.

R.N.L.I.

J. C. Farmer, R.N.L.I.

Captain } Charles B. Mullins.

R.N.L.I. } Outlibert M. Rhms.

Lieut.-Com. } H. Parot.

R.N.V.R. } Lieut. R.N.R. Alastair P. Hadow.

Lieut. } Arthur E. Watts.

R.N.V.R. } P. Romer.

Lieut. } C. P. Serocold.

R.N.V.R. } Henry Howard.

Naval Instr. Guy V. Rayment, B.A.

Fleet Paym. Charles J. E. Rotter,

C.B.

Ernest W. C. Thring.

C. Betton Roberts.

Asst. Paym. Lloyd Hirst.

Asst. Paym. } William H.

R.N.V.R. } Osman.

Midshipman George H. Carbutt.

Civil Staff.

Staff Clerks--

Hugh Broadbent, Esq.

Cartographer--

C. Brickendon, Esq.

11 Second Division Clerks.

1 Confidential Shorthand Writer.

1 Assistant Clerk. 1 Extra Clerk.

2 Boy Clerks, 22 Women Clerks.

6 Draughtsmen.

The following gentlemen have been appointed or lent for temporary service during the War :

Sir P. W. Baker-Wilkinson, Bt., LL.D., P. Cavendish-Bentley, II. N. Dickson, M.A., D.Sc., Esq.,
2nd Lieut. R. L. Hobson (London Post), T. W. H. Inskip, Esq., R.O., 2nd Lieut. S. H. C. Leeson,
Major E. J. Lugard (Indian Army, ret.), Capt. P. Phillips, R. G. C. Poole, J. Randall and H. Russell,
Esqrs.

TRADE DIVISION.

Acting Director of Trade Division...Captain Richard Webb, C.B., R.N.
Acting Assistant Director of Trade Division...Captain Horace W. Longden.

Captain Sidney R. Drury Lowe, C.M.G. W. H. D. Margesson (ret.). B. H. Smith (ret.). T. H. Foster (ret.). Philip Walter (ret.).	Lieut.-Com. John O. Wynn (ret.). Walter P. Koe (ret.). John W. Pugh (ret.).
Commander Thomas Flehar. A. H. Tarleton, M.V.O. (emer.). Sir Charles L. Cust, Bt. K.C.V.O., C.B., C.M.G., C.I.E. (ret.). Maxwell H. Anderson (act.) (ret.). Oscar V. de Satze (ret.). John Kiddle.	Lieut.-Com. } William Clinman. R.N.V.R. } W. E. Arnold-Forster. Lieut. } (Emer.) } Hugh C. Arnold-Forster. Lieut. R.N.R. W. H. Stewart. Lieut. } F. H. McCormick-Goodhart. R.N.V.R. } L. McCormick-Goodhart. Lieut.-Col. ... Thomas H. Hawkins, R.M.L.I. Fleet Paym. ... H. W. Eldon Manley, C.M.G. Alfred L. Parker. Asst. Paym. Harold B. Tuffill. R.N.R. W. A. J. Boxford.
Commander } H. W. Keorick, D.D. (ret.). R.N.R. }	

Staff Clerk... J. T. Cotton, Esq. (act.).
3 Second Division Clerks (one lady).
1 Accountant Clerk (lent).

Civil Staff.

2 Clerical Assistants.
16 Temporary Clerks.
14 Women Clerks.

The following have been appointed for temporary service during the War :

II. S. Moss Blundell, LL.D., Esq. (unpaid).	A. H. Chatteris, Esq.	Olive Lawrence, Esq., Barrister-at-Law.
Sir Frederick Bolton (unpaid).	II. C. Cumberbatch, Esq. (unpaid).	Lieut. E. Macloy (The Camerons).
E. Burns-Pye, Esq. (unpaid).	G. D. Hardinge-Tyler, Esq.	The Earl of Sandwich (unpaid).
Mrs. C. H. Campbell (unpaid).	W. E. Hargreaves, Esq. (unpaid).	

SIGNAL SECTION.

Head of Signal Section...Captain Christopher R. Payne.

Naval Staff.

Commander Basil E. Reinold, Evelard J. Hardman-Jones.	Asst. Paym. ... Edward W. H. Travis. W. F. W. Prior ... Hartington Ratcliffe, 2 Chief Writers (1 pens.).
Staff Paym. John E. A. Brown.	

Civil Staff.

4 Hired Extra Clerks. | 49 Women Clerks.

MATÉRIEL DEPARTMENTS.

DEPARTMENT OF THE DIRECTOR OF NAVAL EQUIPMENT.

Director of Naval Equipment...Captain Clement Grestorex, C.B., M.V.O., R.N.
(Is also Naval Assistant to Third Sea Lord.)

Assistant Directors of Naval Equipment...Captain Henry L. Cochrane, R.N.
Captain Christopher P. Motcuife, D.S.O. (for Salvage work) (ret.).

Salvage Officer in Home Waters...Captain H. Pomroy.
Eng. Captain... (Retd.) Henry U. Teod. Carpenter Lieutenant... Thomas J. Soper.
1 Dockyard Clerk, 2nd grade, 1 Temp. Clerk, 8 Women Clerks, 1 Boy Clerk.

Superintendents of Contract-built Ships.

Captain Brian H. F. Bartolot, M.V.O.	{ For Contract Work (not including Destroyers) on the Clyde. Address—3, Clyde View, Partick, Glasgow. For Contract Work (not including Destroyers) on the Tyne, Thames, Mersey, at Barrow-in-Furness, and at Sunderland. Address—4, Eslington Terrace, Jesmond, Newcastle-on-Tyne.
Captain Laurence B. Power, C.B., M.V.O., A.D.C.	

Superintendent of Torpedo Boat Destroyers Building by Contract.

Captain Cyril Assor, R.N. Address—47, Victoria Street, S.W.

Commander George H. H. Holden (ret.).
Commander Vernon S. Rashleigh.
Commander Sydney B. Boyd-Richardson.
Commander Frank F. Rowe, D.S.O.

Commander James H. Dalham (ret.).
Commander Lewis C. E. Crabbe.
Commander R.N.R. James W. Gracey (act.).
Lieut.-Com. George M. Skinner.

Appendix

DEPARTMENT OF THE DIRECTOR OF NAVAL CONSTRUCTION.

Director of Naval Construction.

B. H. Tennyson & Esq. naut. Esq., C.B.

Superintendent of Construction Accounts and
Contract Work.
W. H. Whiting, Esq., C.B.

Assistant Directors of Naval Construction.

W. J. Henry, Esq.
W. H. Clark, Esq., C.B., M.V.O.
H. Blagden, Esq. (act.).
A. E. Richards, Esq.Superintendent of Admiralty Experiment Works. R. E. Proude, Esq., C.B., M.V.O., F.R.S.
Senior Constructive Officer (re-entered for temp. service during the War). J. A. Yates, Esq.

Chief Constructors.

Assistant Constructors, First Class.

E. L. Atwood (act.).
H. M. Boyland (act.).
W. H. Butler (act.).
T. Dally.
A. W. Johns (act.).
C. W. Murray (act.).
J. H. Narbeth, M.V.O.
E. A. J. Pearce (act.).
P. J. Pollock, Esq.A. Adams.
T. H. Bentley.
C. M. Carter.
H. B. Clavig.
G. H. Child.
E. Hokey.
C. J. W. Hopkins.
J. Innes.
C. S. Lilliecap.
J. McQueen.
S. Payne.
M. P. Spamer.
A. G. W. Stanton.
J. O. Williamson, Esq.

Constructors.

G. H. Hall.
G. Bulkeley (act.).
G. I. R. Campbell (act.).
S. V. Goodall (act.).
G. E. Goodyear.
A. H. Gould (act.).
(temp.).
G. Hannaford (act.).
M. H. Harris (act.).
A. J. Johnson.
J. C. Joubin (act.).
G. W. Kenning (act.).
W. J. Martin.
T. J. Mathias (act.).
F. E. Mayer (act.).
O. A. Payne.
J. Rogers.
W. G. Sanders (act.).
C. Scott (act.).
A. W. Watson (act.).
L. Woullard (act.).
Esqrs.

Assistant Constructors, 2nd Class.

F. T. Blackman.
A. P. Cole.
W. A. D. Forbes.
R. W. L. Gawn.
H. S. Pengelly.
F. C. C. Rogers.
F. Sutcliffe, Esqrs.

Temporary Constructor.

T. D. Ansell, Esq.

Temporary Assistant Constructors.

A. Alkster, B.Sc.
J. Angus, B.Sc.
C. W. Blom, B.Sc.
E. L. Channings, B.Sc.
F. C. Cooke.
D. A. Conkey, B.Sc.
J. J. Craig.
J. L. Davies.
D. L. Evans, B.Sc.
R. Fairley.
T. Graham, B.Sc.
W. R. Hockaday.
R. K. McMillan.
M. M. Parker.
G. McI. Paterson, B.A.
A. P. Patterson, B.Sc.
P. G. Rouse, B.A.
J. H. Bowden, B.Sc.
T. E. Bowden, B.Sc.
F. W. Thorne.
J. O. M. Wilson, Esqrs.

Temporary Acting Assistant Constructors.

G. Chaw.
W. H. Eastcott.
H. B. Hodge.
G. Humphreys.
W. J. Laughton.
F. J. Penrith.
G. Penrith.
A. F. Perkins.
H. Philpott.
F. Skeens.
A. Taylor.
S. F. Thorne.
A. Warren.
B. H. Wells.
G. H. Whiteway, Esqrs.

Inspecting Officer of Smiths' Work...J. T. Pearson, Esq.

Surveyor...C. E. Rawlins, Esq. (Left from Board of Trade).

Curator of Drawings...W. J. Moore, Esq.

Examiner of Construction Accounts...George H. Taylor, Esq.

Confidential Clerks to D.N.C....J. Luffman and S. W. H. Phipps (act.), Esqrs.

Technical Clerk...W. H. Malpas, Esq.

Clerical Assistant to D.N.C....R. J. Wright, Esq. (act.).

32 First Class and 91 Second Class Draughtsmen, 3 Second and 6 Third Grade Dockyard Clerks, 1 Fitted Writer, 13 Fitted Extra Clerks, 21 Women Clerks, 5 Boy Clerks, 1 Interpreter (temp.) 4 Modellers.

The following gentleman has been re-entered for temporary service—

W. C. Thomas, Esq. (Inspecting Officer ret'd.)

Superintending Electrical Engineer...C. H. Worthingham, Esq., M.I.C.E., M.I.M.E., M.I.E.E.

Electrical Engineers, Higher Grade...A. D. Constable, M.I.C.E., William McColliland, A.M.I.E.E. and E. T. Williams, M.I.E.E. (act.), Esqrs.

Electrical Engineers...H. Melville Aickery, M.I.E.E., J. S. Baddoo (act.), F. P. Fletcher, A.M.I.C.E., A.M.I.E.E. (act.), F. O. Forster, M.I.E.E., A. G. Nowington, M.I.E.E., and W. P. Scott, A.M.I.E.E. (act.), Esqrs.

First Assistant Electrical Engineers...W. H. Challen (act.), H. H. R. Green, A.M.I.E.E., and J. Shaw (act.), Esqrs.

Temp. Asst. Electrical Engineers...E. Morton, A.M.I.E.E., and R. W. Willis, A.M.I.E.E., Esqrs.
Examiner of Electrical Accounts...E. J. Rogers, Esq. (act.)

2 Second Assistant Electrical Engineers (act.), 8 First Class, 7 Second Class, and 6 Temporary Draughtsmen, 6 Temp. Clerks, 5 Women Clerks and 2 Boy Clerks.

DEPARTMENT OF THE ENGINEER IN CHIEF.

Engineer-in-Chief of the Fleet...Eng. Vice-Admiral Sir Henry J. Oram, K.O.B., F.R.S.

Deputy Engineer-in-Chief...Eng. Rear-Admiral G. G. Goodwin, C.B.

Eng. Rear-Admiral William J. Ansell.

(Eng. Rear-Admiral Edward Gault).

Assistant Engineers in Chief (Eng. Captain Francis H. Lister (Left Priority Section)).

Eng. Captain Charles W. J. Bearblock (temp.).

Eng. Captain Edward A. Short (ret.) (temp.).

Engineer Inspectors.

Eng. Captain... John H. Jenkin.
Eng. Captain... Arthur S. Orisp.
Eng. Commander John McLaughlin.
Eng. Commander David J. Carruthers.
Eng. Commander Charles G. Ware.
Eng. Commander Arthur E. Myne.
Eng. Commander Francis A. Gordon (*temp.*).
Eng. Commander Lionel M. Hobbs (*lent from R.N. Coll., Greenwich*).

Eng. Commander Thomas G. Proctor.

Civilian Engineer-Overseers..... W. G. Gibbons, C. Gray, W. Letby, W. G. Mathews and M. Ord, Esqrs.

Examiners of Engineering Accounts... Edwin Cadye, and W. J. Stallion, Esqrs. (*act.*), 35 Draughtsmen, 10 *Temp.* Draughtsmen, 1 Dockyard Clerk (Third Grade), 3 Illred Writers, 4 Extra Clerks, 8 *Temp.* Clerks, 11 Women Clerks and 2 Boy Clerks.

Engineer Inspectors—continued.

Eng. Commander William H. Ham.
Eng. Commander John Ifouldton.
Eng. Commander Joseph J. Kirwin.
Eng. Commander Ernest Nibbs (*act.*).
Eng. Commander James J. Sargent (*act.*).

Engineer Lieutenant-Commanders.

Leonard W. Cargoven.	Walter W. Lock.
William S. Mann.	Frederick J. Pedrick.
Harold A. Brown.	Stanley O. Church.
Ernest A. Archard.	George Freese (<i>temp.</i>).
Bertram W. Knott.	Jesse H. Harrison.

Engineer Lieutenant.

Frederick E. G. Turner.

DEPARTMENT OF THE DIRECTOR OF DOCKYARDS.

Director of Dockyards and Dockyard Work... Sir James B. Marshall, K.C.B.

Superintendent of Dockyard Branch—

H. J. Webb, Esq.

Manager, Construction Department—

F. H. Ollis, Esq. (*temp.*) (*For special service.*)

Chief Constructors—

(J. M. Apsey (*temp.*),
 E. R. Bate, Esq. (*add'l.*),
 O. H. Croxford, Esq. (*act.*) (*temp.*).

Constructors—

F. Bryant, Esq.
 W. T. Davis, Esq. (*temp.*).
 G. F. Juddford (*act.*).
 H. B. Wood (*act.*).

For Special Service—

Eng. Rear-Admiral Robert Mayston, C.B. (*ret.*) (*temp.*).

Eng. Rear-Admiral Charles Ridd (*ret.*).

Engineer Assistant to Director of Dockyards—

Eng. Captain John W. Ham.

Engineer Assistants—

Eng. Commander Samuel P. Ferguson.

E. R. Langmaid, Esq.

Chief Engineer... T. E. Elvy, Esq. (*lent from Hawthornles Dockyard*).

Examiners of Dockyard Work—

T. H. Harries, E. A. Lakay, J. D. Gibby (*act.*), J. Ellis, W. J. Coles, F. Sanders, O. Henwood (*act.*), F. J. Fletcher (*act.*), and J. A. Yago (*act.*), Esqrs.

First Assistant Electrical Engineer... E. I. Brain, Esq. (*act.*).

Critical Assistants { G. W. Loveridge, Esq.
 G. C. Stanbury, Esq. (*act.*).

Visiting Inspectors of Timber... W. H. Hooper and Alfred James, Esqrs.

1 Dockyard Clerk (First Grade), 2 Dockyard Clerks (Second Grade), 7 Dockyard Clerks (Third Grade), and 9 Illred Writers.

DOCKYARD EXPENSE ACCOUNTS DEPARTMENT.

(68, Victoria Street, S.W.)

Inspectors of Dockyard Expense Accounts... W. G. Raff, Esq., I.S.O.

Assistant to above... J. Ryan, Esq.

Expense Accounts Officer... F. W. W. Burrell, Esq.

Deputy Expense Accounts Officer... G. T. Jones, Esq.

Assistant Expense Accounts Officer... T. Platt, Esq. (*for Stocktaking Duties*).

T. Jennings, Esq. (*for Stocktaking Duties*), and
 J. A. Jeffery, Esq. (*act.*)
 F. Hall, Esq. (*temp.*).

Examiner of Accounts... H. Haggis, Esq.

Assistant Examiner of Accounts... J. H. Horswell, Esq.

2 Dockyard Clerks (Second Grade), 6 Dockyard Clerks (Third Grade), 8 Illred Writers
 1 Assistant Clerk, 3 *Temp.* Clerks and 6 Women Clerks.

DEPARTMENT OF THE DIRECTOR OF NAVAL ORDNANCE.

Director of Naval Ordnance and Torpedoes... Rear-Admiral Morgan Singer, C.B.

Assistant-Director of Torpedoes... Captain Philip W. Dumas, C.V.O., C.B.

Assistant-Director of Naval Ordnance... Captain Herbert R. Norbury.

Assistants to Director of Naval Ordnance and Torpedoes.

Commander Charles A. Scott.
 Commander Frederic B. B. (1) Schreiner.
 Commander Edward O. Cochran.
 Commander James S. O. Salmon.
 Commander (ret.) Malcolm K. Grant.
 Commander Isham W. Gibson, R.N.V.R.
 Commander Bernard W. M. Fahlman.
 Lieut.-Com. Kenneth B. M. Churchill.
 Acting Com. Archibald Gilbert (temp.).

Acting Commander Gaud B. Rucey (ret.) (temp.).
 Acting Commander Gulton (1) Sherman (ret.) (temp.).
 Commr. R.N.V.R. John G. Henderson (act.).
 Lieut. Walter R. Gilbert.
 Lieut. Willie B. Kilroy, R.N.V.R. (temp.).
 Lieut. Herbert O. Block, R.N.V.R. (temp.).
 Sub-Lieut. W. H. J. Fildridge, R.N.V.R. (temp.).

Lieutenant...Patrick P. Coleman.

Chief Gunners...Frederick J. Payne, Malcolm A. McKenzie.

Gunner...(T) Leonard Henton, W. Thorogood, Walter F. Williamson.

Engineer Inspectors.

Eng. Rear-Admiral Ernest F. Ellis, C.B. (ret.).
 Eng. Captain Thomas Thorne (temp.).
 Eng. Commander Henry Wall.
 Eng. Commander Edward O. Hefford.

Eng. Commander William Hart.
 Eng. Commander Alfred R. Kemp.
 Eng. Lieut. Commander Frederick I. Robertson.

Chief Inspector of Naval Ordnance...Commander (act.) John A. Duncan, C.B.

Assistants to Chief Inspector of Naval Ordnance...Commander Digby St. A. P. Weston (ret.).
 Commander Henry C. E. Boyan (ret.).
 Commander (act.) Leslie J. L. Hammond (ret.).
 Captain Freeman C. N. Bishop, R.N.A.

The following gentleman has been lent for special service during the War...J. Storoy, Esq.

Naval officers employed on Inspection and Experimental Ordnance Duties.

Under Chief Inspector of Naval Ordnance:—

Inspector of Steel...Commander Harold G. Jackson (ret.).

Assistant Inspectors of Steel.

Admiral (ret.) Sir Edmund S. Poe, C.S.V.O., E.C.N.
 Major-General R. Wece, C.B. (temp.).
 Captain H. B. Evans, R.N. (ret.).
 Captain William H. M. Doulle, R.N. (ret.).
 Captain Claude W. M. Plenderleath, R.N. (ret.).
 Commander Henry Thompson (ret.).
 Commander Charles K. McCallum (ret.).
 Commander John H. Bray (ret.).
 Commander T. H. Gooch (Emerg.).
 Commander A. H. Tremayne (ret.).
 Commander Reginald G. Brenton (Emerg.) (temp.).
 Commander W. F. Gibson, C.B., R.N.R. (ret.).
 Lieut.-Com. Arthur W. Tomlinson.
 Lieut.-Com. Frank H. Willis.
 Lieut.-Com. Hugh J. Orr (ret.).
 Lieut.-Com. Llewellyn E. H. Llewellyn (ret.).
 Lieut.-Com. John C. M. McFarley (ret.).
 Lieut.-Com. Albert D. Grant (ret.).
 Lieut.-Com. Robert F. Vencey (ret.).
 Lieut.-Com. Allister W. McDonald (ret.).

Lieut.-Com. Ralph B. Bodilly (ret.).
 Lieut.-Com. William H. O'Neill (ret.).
 Lieut.-Com. Henry L. Cheston (Emerg.) (act.).
 Lieut.-Com. Frederick J. Davis, R.D., R.N.A. (ret.).
 Lieut.-Com. W. B. Compton (ret.).
 Lieut.-Com. W. G. H. Cive (ret.).
 Lieut.-Com. H. J. G. Lawrence (ret.).
 Lieut.-Com. J. H. C. Ogilvy (ret.).
 Lieut. Henry S. H. Ellis (ret.).
 Lieut. Robert J. Sweet (ret.).
 Lieut. H. N. H. Beauchamp H. Verner (ret.).
 Colonel J. H. J. Jocelyn, R.A. (ret.) (temp.).
 Lieut.-Colonel T. English, R.D. (ret.) (temp.).
 Lieut.-Col. G. Mackinlay, R.A. (ret.) (temp.).
 Lieut.-Col. R. L. Haines (ret.) (temp.).
 Major Charles A. Bishop, R.N.A.
 Captain G. B. Macpherson Grant (temp.).
 Captain Alfred D. B. Godfrey, R.N.A.
 Eng. Capt. H. W. Metcalf (ret.).

The following gentlemen have also been appointed for temporary service during the War:

H. B. Halls, C. J. Hill, A. E. Lee, L. T. Jarvis, J. W. Capstick, C. E. Moss,
 W. R. O. Hockin, R. Curry-Hinton, T. W. Sheppard, Esqrs.

Lent from Home Offices.

H. Topham, R. R. Bennett, A. O. Lowe, G. O. Sumner, E. J. Meeklin, C. F. Hunter, W. H. Mead,
 W. Turner, F. Bowen, A. A. Hepburn, C. H. Taylor, C. E. Plumbo, F. W. Cockshott, A. Fother-
 ingham, L. D. Hooper, H. T. Klugdove, and W. O. Evans, Esqrs.

Under War Office.

Lieut.-Com. John A. L. Hay.

Lieut.-Com. Archibald C. Gooden (ret.).

Captain Nathaniel F. Trotman, R.N.A.

The following gentlemen have been appointed for temporary service during the War:
 J. L. Capes, H. Jackson, A. McPherson, and F. R. Coursey, Esqrs.

Superintending Clerk...Thomas G. Anderson, Esq.

Deputy Superintending Clerk...W. E. Daniels, Esq. (act.).

Assistant Superintending Clerks...F. Morrison, S. W. Smith (act.) and G. Stevens (act.), Esqrs.

Second Division Clerk, Dockyard Clerks (including Acting) First Grade 1, Second Grade 9, Third Grade 9, Temporary Clerks and Boys 49, Draughtsmen 7.

Superintendent of Ordnance Stores...Captain Barrington H. Chevallier, R.N. (retired).
Assistant Superintendent of Ordnance Stores...H. Fethers.

Proctorial Ward (act.).

C. E. Woodward (act.), Esqra.

Superintending Clerk...A. McFarlane, Esq. (act.).

Naval Ordnance Store Officer...W. A. Mortimer (act.), Esq.

Deputy Ordnance Store Officers...T. W. Midmer (detached for Special Duty), W. H. Rowe (act.), N. Thomson, and W. Vaughan, Esqrs.

Assistant Ordnance Store Officers...J. A. W. Ballard (act.), C. G. Chivers (act.), W. E. Eyles (act.), O. H. Murray (act.), and A. T. Reed (act.), Esqrs.

Examiner of Naval Ordnance Work...W. D. Evans, Esq. (act.).

- 1 Ordnance Depot Clerk, First Grade.
- 4 Ordnance Depot Clerks, First Grade (act.).
- 13 Ordnance Depot Clerks, Second Grade (act.).
- 6 Ordnance Depot Clerks, Third Grade.
- 7 Ordnance Depot Clerks, Third Grade (act.).
- 1 Titled Writer.
- 13 Temporary Titled Extra Clerks.
- 14 Temporary Women Clerks.
- 6 Boy Clerks and Boy Writers.

Acting Assistant Ordnance Store Officer...Shaffield...G. Swift, Esq.

Chief Analyst...Shaffield...John O. W. Humphrey, Esq.

NOTE.—Officers of the Naval Ordnance Department serving at Woolwich and at the Ports are not given.

AIR DEPARTMENT.

Director of Air Services *Rear-Admiral Charles T. Vaughan-Lee.*
Chief Assistant *W. G. Ferris, Esq.*
Private Secretary *Paymaster (act.) G. H. Thomson.*

Superintendent of Aircraft Construction *Captain Murray F. Sueter, O.B.*
(Commodore 1st Class.)

Naval Assistant *Captain A. V. Vyvyan, D.S.O.*

Asst. Supt. of Aircraft Construction *Captain D. T. Norris.*

Asst. Supt. of Engines *Captain A. J. Davies.*

Personnel Captain *Wing Commander R. H. Clark-Hall.*

Inspecting Captain of Air Training *Wing Commander (Ed) W. Briggs (act.).*

Captain *Captain H. Edwards, D.S.O.*

Military Liaison Officer *Wing Commander H. D. Briggs.*

Commander *Lord Dunboyne.*

Commander *Lieut. J. B. Pike, R.N.O.*

Wing Commanders.

J. L. Forbes. | *C. R. J. Randall.* | *H. L. Woodcock.*
R. C. S. Hunt. | *J. W. Seddon.* |

Squadron Commanders.

P. F. M. Follows. | *J. D. Mackworth.* | *H. A. Williamson.*
O. H. K. Edmonds, D.S.O. |

Flight Commanders.

J. W. K. Allsop. | *H. A. Michell.* | *S. V. Slope, D.S.O.*
J. Bird (act.). | *R. C. M. Pink.* |

Lieutenant-Commander *J. I. Harrison.*
Engineer-Commander *Francis Rankin (act.).*
Env.-Lieut.-Commander *A. Lennon-Berry.*
Engineer-Lieutenant *St. Stanmore.*
W. A. C. Sandford-Thompson.

Flight Lieutenants.

F. A. Brook. | *L. H. Hardstaff.* | *R. V. Sanson.*
W. A. Burns. | *L. J. Killmayer.* | *M. B. A. Wright.*
G. W. Cranfield. | *W. C. Michie.* |
A. O. French-Brewster. | *E. J. O. Roberts.* |

Flight Sub-Lieut. *D. W. Gray.*
F. F. Reeves.

Warrant Officers (1st grade).

F. W. B. H.

Appendix

Warrant Officers (2nd grade).

L. G. Abbott,
J. V. Collins,
H. G. Cooper,
W. T. Curblast.

W. N. Fornaby,
J. H. Hobbs,
C. Layzell-Apps,
J. S. Matthews.

C. Y. Mitchell,
J. Ormsby,
W. G. J. Warilla.

Lieut.-Commanders, R.N.V.R.

W. A. Bristolow,
Lord Enslin.

C. Holmes,
G. F. Jenkins.

F. C. H. Shuchair.

Lieutenants, R.N.V.R.

C. R. Abbott,
M. H. P. Allen,
C. R. Andrews,
P. T. Armstrong,
J. Arthur,
T. M. Barlow,
T. B. Barrington,
W. O. Bentley,
R. B. Berkeley,
A. B. Blyth,
T. H. B. Hunt,
J. P. Bourke,
J. H. Buchanan,
F. A. Bumpus,
C. Caird,
J. D. Carmichael,
B. G. Carter,
C. H. Childs,
R. H. Cookshott,
J. Craig,
J. C. T. Crawford,
J. C. Currie,
J. K. Curwen,
C. R. D'Arcy,
H. L. Dear,
H. Dodd,
J. G. Duthie,
J. W. Eschford,
J. P. Ekliden,
A. P. Evans,
A. W. Farrer.

W. R. Flint,
S. Phinver,
J. M. Fraser,
A. B. Gaultie,
R. D. M. Gilmore,
R. S. Goddard,
D. Gordon,
W. G. Grant,
J. E. A. (rentorex),
H. P. Hamilton,
J. P. Hedley,
H. A. Hethcunton,
S. R. Hill,
B. Hogg,
T. O. B. Hooke,
W. H. Horton,
B. C. Howley,
D. G. M. Thorne,
A. J. Hush,
A. G. Ioudica,
C. Kent,
A. Landells,
W. A. Lawrence,
H. B. Leach,
G. E. Lygo,
G. McAlpine,
W. J. Marsh,
T. A. Monekton,
S. R. Mullard,
W. H. Mulville.

C. J. Murfit,
G. G. Neilson,
T. F. Norbury,
T. L. Oliver,
T. A. Parker,
H. M. N. Perko,
F. M. Pollard,
W. J. Polybank,
O. L. Powell,
J. S. M. Pyke,
G. M. T. Rees,
A. Robertson,
T. B. Rogers,
E. S. Saunders,
J. C. Savage,
K. Seacole,
L. G. Shiro,
N. Sladden,
A. P. H. Smallpiece,
S. P. Smyth,
S. B. Spencer,
O. A. W. Taylor,
A. K. Toulmin-Smith,
S. M. Udale,
J. B. Vernon,
H. N. Warburton,
A. H. White,
W. S. Whitelaw,
P. C. Williamson,
H. E. Wimperley.

Sub-Lieutenants, R.N.V.R.

A. C. Baker,
J. G. M. Boyan,
E. G. Blake,
E. Butt,
C. A. Crow,
J. W. O. Dobbryn.

H. Eves,
J. D. Greenwood,
A. H. Briggs,
J. H. Hagon,
R. H. Haworth,
G. Hazellon.

M. J. H. Molyneux,
A. P. Reed,
B. Thompson,
T. M. Wilson,
N. H. Woolf,
C. H. Wright.

2nd Lieutenant...A. Berry.
Ch. Gunner...A. Daynton.

Civil Staff.

Deputy Superintending Clerk...R. W. Griffin, Esq.
Chief Examiner...J. H. Jones, Esq. (act.).
(Lent from Inland Revenue.)
Examiner...G. R. Pledger, Esq. (act.).
(Lent from Inland Revenue.)
Inspector of Aircraft Armament...R. D. Dow, Esq.
2 Minor Staff Clerks (act.).
4 Second Division Clerks (2 serving with Army).
5 Assistant Clerks (1 serving with Army).
1 Extra Clerk, 1st Class.
1 Temp. Accountant Clerk, 1st Class.

2 Asst. Inspectors of Aircraft Armament.
51 Temporary Clerks.
Improvers.
8 Temporary Women Clerks, Higher Grade.
78 Temporary Women Clerks.
7 Boy Clerks.
Civilian Technical Assistant...Harris Booth, Esq.
Asst. Technical Adviser...H. Boland, Esq. (temp.).
A. J. S. Phippard, Esq.
F. E. Cowlin, Esq.
0 Draughtsmen.

NOTE.—The Officers of the Royal Naval Air Service are not shown.

(b) ADMIRALTY, APRIL, 1917.

First Sea Lord.....Admiral Sir John Jellicoe, G.C.B., &c.

ADMIRALTY WAR STAFF.

*Chief of the War Staff.....Vice-Admiral (ret.) Sir Henry F. Oliver, G.C.B., M.V.O.
Assistant to the Chief of the War Staff...Captain Arthur de K. L. May.*

Staff Clerk W. H. Hancock, Esq. (act.).

OPERATIONS DIVISION.

Directors of the Operations Division.....Rear Admiral Thomas Jackson, G.B., M.V.O.

Captain George F. W. Hope, C.B., Act'.

Assistant Directors of the Operations Division...Captain Henry W. Grant.

Lieut.-Col. Walter T. C. Jones, D.S.O., R.M.L.I.

Naval and Marine Staff.

Captain.....A. G. Allgood (ret.)

A. E. Beal.

R. D. Clutton (ret.).

C. G. S. Beles (ret.).

W. M. Kerr.

C. Seymour.

Fl. J. L. W. K. Wilcox.

Charles D. Roper (temp.).

Herbert MacL. Edwards (temp.).

Commander Frederic G. S. Pelle.

Charles C. Dix, D.S.O.

W. Bowden-Smith (ret.).

H. V. S. O. Messum (ret.).

T. W. Stirling (emera.).

Leonard Robinson (act.).

Hugh A. Williamson (act.).

Maj. & Lt. Col. } Fitzrobert J. F. French.

Col. R.M.A.

Lieut.-Col. J. P. Gibbs.

Civil Staff.

Staff Clerk...G. J. Rickman, Esq.

2 Second Division Clerks.

1 Confidential Shorthand Writer.

11 Assistant Clerks.

2 Accountant Clerks.

3 Extra Clerks.

INTELLIGENCE DIVISION.

Director of the Intelligence Division...Captain William R. Hall, G.B., AdO.

Assistant Directors of the Intelligence Division...Captain Raymond A. Mearns (temp.).

Captain Thomas E. Wardle, D.S.O.

Naval and Marine Staff.

Captain.....Herbert W. W. Hooper.

Argentine H. Allington.

Rupert B. Gwatkin.

Williams (ret.).

Commander Vivian R. Brandon.

Francis G. G. Clifton.

Colpoys C. Walcott

(ret.).

Ernest F. Gregory.

Gerald C. Dickens.

Morris E. Cochrane,

D.S.O. (ret.).

John Casement.

Geoffrey B. Spicer-

Simson, D.S.O.

Reginald A. Norton

(temp.).

Commander } Henry F. C. Caven-

(Emora.) } dish.

Commander } Lord Perscholl,

R.N.V.R. } K.C.V.O.

Lt. Col. William

Coxens-Hardy, K.C.

C. P. Serocold.

Lord Abinger.

Lieut.-Com. Walter T. Bagot.

Arthur W. Wood

(ret.).

Eng. Com....Percy Wheeler.

Maj. & Lt. } Frank V. Temple.

Lt. Col. } R.M.L.I.

Maj.Walter Sindair.

R.M.L.I.

Percy R. Heycock,

R.M.A.

Capt. & } Arthur Peel, R.M.L.I.

Lt. Maj. }

Captain ...Ocell R. S. Wright,

R.M.L.I.

Bernard F. Trenoh,

R.M.L.I.

J. Q. Farmer,

R.M.L.I.

Captain } Charles B. Mullins.

R.M.L.I. }

Lieut.-Com. } H. Paget.

R.N.V.R. }

Lieut. R.N.R. Alastair P. Hadow.

Lieut. } Arthur E. Watts.

R.N.V.R. } F. Bonner.

Hyde Kennard.

Lieut. } Henry M. Howard.

R.N.V.R. }

Naval Instr. Gny V. Raymond, D.A.

Fleet Paym. Charles J. E. Rottor,

G.B.

Ernest W. C. Thring.

C. Bolton Roberts.

Asst. Paym. Lloyd Hirst.

Asst. Paym. } William H. Osman.

R.N.V.R. }

Midshipman George H. Carbutt.

Appendix

Civil Staff.		
Staff Clerks...	Cartographer...	1 Assistant Clerk, 3 Extra Clerks.
Hugh Broadbent, Esq.	G. Brickenden, Esq.	2 Boy Clerks, 27 Women Clerks.
W. G. Johns, Esq. (act.).	4 Second Division Clerks.	4 Draughtsmen.
A. Hinchhouse, Esq. (act.).	1 Confidential shorthand Writer.	

The following gentlemen have been appointed or lent for temporary service during the War :

Sir P. W. Baker-Willsham, Bt., LL.D., P. Cavendish-Bentley, A. Cecil, H. N. Dickson, M.A., D.Sc.,
(Lt. H. Fitzmaurice, Esq., 2nd Lieut. R. L. Johnson (London Regt.), T. W. H. Inskip, Esq., R.O.,
2nd Lieut. B. S. G. Leeson, H. Lovison, Esq., Major H. J. Tagard Indian Army, (act.), T. G. F.
Palmer, Dr. C. Copland Perry, J. Rawball, H. Russell, and P. N. Schiller, Esq.,

TRADE DIVISION.

Acting Director of Trade Division... Captain Richard Welsh, C.B., R.N.		
Acting Assistant Director of Trade Division... Captain Horace W. Longden.		
Captain	W. H. D. Margesson (ret.).	Lieut.-Com. { William Gilman.
	B. H. Smith (ret.).	R.N.V.R. { W. F. Arnold-Foster (temporarily detached).
	T. H. Foster (ret.).	Lieut. { Lionel A. Cassel (temp.).
	Philip Walter (ret.).	William A. Willock (temp.).
	Reginald L. Cleghorn (ret.).	Lieut. { Hugh C. Arnold-Foster.
Commander	Thomas Fisher.	(Emerg.) { W. H. Stewart.
	A. H. Tarleton, M.V.O. (emer.).	Lieut. R.N.R. { F. H. McCormick-Goodhart.
	Sir Charles I. Cust, M., K.C.V.O., (C.B., C.M.G., C.I.E. (ret.).	R.N.V.R. { L. McCormick-Goodhart.
	Maxwell H. Anderson (act.) (ret.).	John B. D. Joco.
	Osbert V. de Salaz (ret.).	Arthur N. Fielden.
	John Kiddie.	Eng. Com. ... Henry G. Nash (ret.).
	Walker P. Rno (ret.) (act.).	Lieut.-Col. { Thomas H. Hawley, R.M.L.I.
	Lieut. Col. Mulloney.	Fleet Paym. { H. W. Eklon Mansley, C.M.G.
	Edward H. Compton (ret.).	Alfred E. Parker.
	Andrew L. Strange.	Staff Paym. { John Eldridge (temp.).
Commander {	H. W. Kenrick, M.P. (ret.).	Sub-Lieut. { Henry J. R. Malsland.
Lieut.-Com. {	John O. Wyatt (ret.).	R.N.V.R. { Alexander R. Mollison.
	John W. Pugh (ret.).	Asst. { Harold B. Tuffill.
	Francis J. Alexander (ret.).	Paym. { W. A. J. Boxford.
		R.N.R. { Joseph H. Wilson.

Staff Clerk... J. T. Cotton, Esq. (acting).
8 Second Division Clerks (one lent).
1 Accountant Clerk (lent).

Civil Staff.

2 Clerical Assistants.
18 Temporary Clerks.
14 Women Clerks.

The following have been appointed for temporary service during the War :

H. S. Moss Blundell, LL.D., Esq. (unpaid).	H. C. Cumberbatch, Esq. (unpaid).	Olive Lawrence, Esq., Barrister-at-Law.
Sir Frederick Bolton (unpaid).	Allan Danson, Esq. (unpaid).	Lieut. E. Molay (The Cameronians).
H. Burns-Pye, Esq. (unpaid).	G. D. Harding-Tyler, Esq.	The Earl of Sandwich (unpaid).
Mrs. C. H. Campbell (unpaid).	W. H. Hargreaves, Esq. (unpaid).	
A. H. Charkis, Esq.		

ANTI-SUBMARINE DIVISION.

Director... Rear-Admiral Alexander L. Duff, C.B.
Secretary... I. D. M. Cavanagh.
Assistant Directors... Captain H. Watwyn, D.S.O.
Claude Seymour, D.S.O.

Staff.

Commander... (N) I. W. Carrington.	Commander... A. M. Yents-Brown.
(S.R.) G. R. Lewis.	Lieut.-Com. (T) H. L. Illidius.
(G) B. H. Russell.	(N) I. W. Clayton.
(G) Reginald G. H. Henderson.	Eng.-Com. R. W. Riley.

Captain of Mine Sweeping... Captain L. G. Preston, C.B.

SIGNAL SECTION.

Head of Signal Section... Captain Christopher R. Payne.

Naval Staff.

Commander... Edward J. Hardman-Jones.	Paymaster Edward W. H. Travis (act.).
Capt. de Bt. Maj. R.M.A. Stephen C. Wase.	1st Writer... Eastington Eskeliffe.
Staff Paym. ... John B. A. Brown.	2 Chief Writers (1 pensd.).

Civil Staff.

4 Hired Extra Clerks.

1 40 Women Clerks.

<i>Temporary Acting Assistant Constructors.</i>			
G. Chase.	W. J. Loughton.	H. Philpot.	A. Warren.
W. H. Eastcott.	P. J. Pamiler.	F. Skene.	M. R. Wells.
J. H. Dodge.	C. Penny.	A. Taylor.	C. H. Whiteway.
G. Munisott.	A. F. Perkins.	S. F. Thorne.	Esqs.

Inspecting Officer of Smiths' Works... E. T. Pearson, Esq.

Surveyor... C. E. Rawbone, Esq. (*Lent from Board of Trade*).

Curator of Drawings... W. J. Moore, Esq.

Examiner of Construction Accounts... George H. Taylor, Esq.

Confidential Clerks to D.N.C.... J. Luffman and S. W. R. Pippett (act.), Esqs.

Technical Clerk... W. H. Malpas, Esq.

Clerical Assistant to S. C. W.... R. J. Wright, Esq. (act.).

32 First Class and 91 Second Class Draughtsmen, 3 Second and 6 Third Grade Dockyard Clerks, 1 Third Writer, 18 Third Extra Clerks, 21 Women Clerks, 5 Boy Clerks, 1 Interpreter (*Emp.*), 4 Modelers.

The following gentlemen has been re-entered for temporary service—

W. C. Thomas, Esq. (*Inspecting Officer ret.*).

Superintending Electrical Engineer... C. H. Worthingham, Esq., M.I.C.E., M.I.M.E., M.I.E.E.

Electrical Engineers, Higher Grade... A. D. Constable, M.I.E.E., William McClelland, A.M.I.E.E., and B. E. Williams, M.I.E.E. (act.), (Esqs.).

Electrical Engineers... H. Melville Acker, M.I.E.E., J. S. Deddon (act.), F. P. Fletcher, A.M.I.C.E., A.M.I.E.E. (act.), F. C. Forster, M.I.E.E., A. G. Nowington, M.I.E.E., and W. P. Scott, A.M.I.E.E. (act.), Esqs.

First Assistant Electrical Engineers... W. H. Chatter (act.), H. H. R. Green, A.M.I.E.E., and J. Shaw, A.M.I.E.E. (act.), Esqs.

Temp. Assk. Electrical Engineers... F. Morton, A.M.I.E.E., and R. W. Willis, A.M.I.E.E., Esqs.

Examiner of Electrical Accounts... E. B. Rogers, Esq., A.M.I.E.E. (act.).

Clerk in Charge... J. Hall, Esq.

2 Second Assistant Electrical Engineers (act.), 8 First Class, 7 Second Class, and 5 Temporary Draughtsmen, 6 Temp. Clerks, 6 Woman Clerks and 2 Boy Clerks.

DEPARTMENT OF THE ENGINEER IN CHIEF.

Engineer-in-Chief of the Fleet... Eng. Vice-Admiral Sir Henry J. Oram, K.C.B., F.R.S.

Deputy Engineer-in-Chief... Eng. Rear-Admiral G. G. Goodwin, C.B.

Eng. Rear-Admiral William J. Anstey, C.B.

Assistant Engineers-in-Chief { *Eng. Rear-Admiral Edmund Gaudin,*
Eng. Captain Francis H. Lister (Lent Priority Section),
Eng. Captain Charles W. J. Bearblock (temp.),
Eng. Captain Edward A. Short (ret.) (temp.).

Engineer Inspectors:

Eng. Captain Percy D. Martell (act.) (temp.).

Eng. Commander John McLaurin.

David J. Carruthers.

Charles G. Ware.

Arthur B. Hynes.

Francis A. Gordon (temp.).

Lionel M. Hobbs (*lent from R. N.*

Coll., Greenwich).

Thomas G. Procter.

William H. Ham.

John Hamilton.

Joseph J. Kirwin.

Engineer Inspectors—continued.

Eng. Commander Frederick W. Marshall.

Ernest Nibbs (act.).

James J. Sargent (act.).

George Procca (temp.).

Engineer Lieutenant-Commanders.

William S. Mann.

Stanley C. Church.

Bortram W. Knott.

Jesse H. Harrison.

Walter W. Lock.

George Villar.

George W. Odum.

Harry H. Carter.

Frederick J. Podrick.

Edwin F. St. John.

Engineer Lieutenant Frederick R. G. Turner.

John S. Orr.

Civilian Engineer-Overseers... W. G. Gibbons, C. Grey, W. Lotfy, W. G. Mathews and M. Ord, Esqs.

Examiners of Engineering Accounts... Edwin Gedye, and W. J. Stallion, Esqs. (act.), 86 Draughtsmen, 10 Temp. Draughtsmen, 1 Dockyard Clerk (Third Grade), 3 Third Writers, 4 Extra Clerks, 8 Temp. Clerks, 11 Women Clerks and 2 Boy Clerks.

DEPARTMENT OF THE DIRECTOR OF DOCKYARDS.

Director of Dockyards and Dockyard Work... Sir James B. Marshall, K.C.B.*Superintendent of the Dockyard Branch—*

H. J. Webb, Esq.

*Manager Constructive Department—*F. B. Ollis, Esq. (temp.). (*For Special service.*)*Chief Constructors—*

G. M. Apsey (temp.).

B. R. Bate, Esq. (add'l.).

O. H. Croxford, Esq. (act.) (temp.).

Constructors—

F. Bryant, Esq.

W. T. Davis, Esq. (temp.).

G. F. Jaudford (act.).

J. MacQueen (act.).

H. B. Wood (act.).

For Special Service—

Eng. Rear-Admiral Robert Mayston, C.B. (ret.) (temp.).

Eng. Rear-Admiral Charles Ridd.

*Engineer Assistant to Director of Dockyards—**Engineer Assistants—*

Eng. Commander Samuel H. Ferguson.

Percival C. W. Howe.

T. R. Elvy, Esq.

E. H. Langmaid, Esq.

Chief Engineer... T. E. Elvy, Esq. (*lent from Hauboulme Dockyard.*)*Examiners of Dockyard Work.*

T. H. Harries, M. A. Lacey, J. D. Gibby (act.), J. Ellis, W. I. Colas, F. Sanders, O. Henwood (act.), F. J. Fletcher (act.), and J. A. Yago (act.), Esqrs.

First Assistant Electrical Engineer... T. L. Brain, Esq. (act.).*Clerical Assistants* { G. W. Loveridge, Esq.
(G. O. Stanbury, Esq. (act.).*Visiting Inspectors of Timber...* W. H. Hooper and Alfred James, Esqrs.

1 Dockyard Clerk (First Grade), 2 Dockyard Clerks (Second Grade), 7 Dockyard Clerks (Third Grade), and 6 Illred Writers.

PRIORITY SECTION.

Director... Vice-Admiral Arthur X. Moggridge.*Assistant Director (Nowah)...* Engineer Captain F. H. Lister, R.N.*Assistant Director (Oibih)...* M. F. Gauntlett, Esq., O.R.M., I.C.S. (temp. *lent from India Office*).

Eng. Rear-Admiral Charles W. Gregory (ret.).

James M. Thompson (ret.).

Albert B. L. Westaway (ret.) (Bristol).

Eng.-Capt.

Jasper W. A. Farrott (ret.).

William A. Howlett (ret.).

Joseph Langmaid (ret.).

Assistant Examiner, 1st Grade (act.)... G. W. Hally, Esq. (*lent from Contract Department*).

1 Assistant Clerk, 1 Improver, and 10 Women Clerks.

*The following gentlemen have been appointed or lent from other Departments for temporary service during the War:*J. T. (Wym), I.C.S., G.H.N. Kendall, I.C.S. (*India Office*).G. B. Sanson, (*Foreign Office*), and M. L. Winter, I.C.S., Esqs.

DOCKYARD EXPENSE ACCOUNTS DEPARTMENT.

(98, Victoria Street, S.W.)

Inspector of Dockyards Expense Accounts... W. G. Roff, Esq., I.S.O.*Assistant to ditto...* J. Ryan, Esq.*Expense Accounts Officer...* T. W. W. Burrell, Esq.*Deputy Expense Accounts Officer...* G. T. Jones, Esq.*Assistant Expense Accounts Officer...* T. Platt, Esq. (*for Stocktaking Duties*).T. Jennings, Esq. (*for Stocktaking Duties*), and

J. A. Joffroy, Esq. (act.).

F. Hall, Esq. (Genl.).

Examiner of Accounts... H. Haggis, Esq.*Assistant Examiner of Accounts...* J. F. Horswell, Esq.2 Dockyard Clerks, Second Grade, 4 Dockyard Clerks, Third Grade, 8 Illred Writers,
1 Assistant Clerk, 3 Temp. Clerks and 6 Women Clerks.

DEPARTMENT OF THE DIRECTOR OF NAVAL ORDNANCE.

Director of Naval Ordnance...Captain Frederick C. Dreyer, C.B.

Assistant Director of Naval Ordnance...Captain Herbert R. Nodbury.

Assistants to Director of Naval Ordnance.

Commander Charles A. Scott.
Edward C. Cochran.
Isaac W. Gibson, R.N.V.O.
Bernard W. M. Whirlman.
Archibald Gillett (act.).
Commr. R.N.V.R. John G. Henderson (act.).

Lieut.-Com. Kenneth B. M. Churchill.
Lieut. Walter B. Gilbert.
Willie D. Kilroy, R.N.V.R. (temp.).
Herbert O. Mook, R.N.V.R. (temp.).
Sub-Lieut. W. H. J. Bridge, R.N.V.R. (temp.).

Lieutenant Frederick J. Payne.
Chief Gunner...Malcolm A. MacKenzie

Engineer Inspectors.

Hon. Rear-Admiral Ernest G. Ellis, C.B. (ret.).
Eng. Captain Thomas Thorne (temp.).
Eng. Commander Henry Wall.
Edward C. Medford.

Eng. Commander William Hatt.
Alfred E. Kempf.
Vernon A. A. 't Hoen.
Frederick L. Robertson (act.).

Chief Inspector of Naval Ordnance...Commander (act.) John A. Duncan, C.B.
Assistants to Chief Inspector of Naval Ordnance...Commander Digby St. A. P. Weston (ret.).
Commander Henry G. R. Bovan (ret.).
Commander (act.) Leslie J. I. Hammond (ret.).
Captain Freeman C. N. Bishop, R.N.A.

The following gentlemen have been lent for special service during the War...J. Storey, Esq.

Naval Officers employed on Inspection and Experimental Ordnance Duties.

Under Chief Inspector of Naval Ordnance:—

Inspector of Steel...Commander Harold G. Jackson (ret.).

Acting Inspector of Steel...Lieut.-Com. Lowellyn E. H. Lowellyn (ret.)

Assistant Inspectors of Steel.

Admiral (ret.) Sir Edmund F. Poe, C.B., C.V.O., K.C.B.
Major-General R. Waco, C.B., R.A. (temp.).
Captain H. B. Evans, R.N. (ret.).
William H. M. Dandell, R.N. (ret.).
Claude W. M. Plenderleith, R.N. (ret.).
William H. P. Taylor, R.N. (ret.).
Commander Henry Thompson (ret.).
Charles K. McCallum (ret.).
John B. Bray (ret.).
T. F. Good (temp.).
A. H. Tromayne (ret.).
Reginald C. Bruton (temp.).
Commander R.N.R. W. F. Caborne, C.B., R.D. (ret.).
Lieut.-Com. Arthur W. Tomlinson.
Frank E. Willis.
Hugh J. Orr (ret.).
John G. M. Maffady (ret.).
Robert F. Vasey (ret.).
Alister W. McDonald (ret.).

Lieut.-Com. Ralph B. Bodilly (ret.).
William H. Callwell (ret.).
Henry L. Cheston (temp.) (act.).
Frederick J. Davis, R.D., R.N.A. (ret.).
W. M. Compton (ret.).
W. G. H. Cree (ret.).
H. J. G. Lawrence (ret.).
J. H. C. Ogilvy (ret.).
Lieut. Henry B. H. Ellis (ret.).
Robert J. Sweet (ret.).
Lieut. R.N.R. Beauchamp H. Venner (ret.).
Lieut. R.N.V.R. Tom M. Chambers.
Colonel (temp. Brig.-Gen.) Cooper Penrose, R.N.
Colonel J. R. J. Jocelyn, R.A. (ret.) (temp.).
Lieut.-Col. T. English, R.N. (ret.) (temp.).
G. Macdonlay, R.A. (ret.) (temp.).
R. L. Haines (ret. temp.).
Major Charles A. Bishop, R.N.A.
Captain C. B. Macpherson Grant (temp.).
Captain Alfred D. B. Godfrey, R.N.A.
Eng. Capt. H. W. Micalife (ret.).

The following gentlemen have also been appointed for temporary service during the War:

H. B. Hall, C. J. Hill, A. E. Lee, L. T. Jarvis, J. W. Canstick, C. E. Moss,
W. B. C. Hoskin, R. Carey-Bronton, T. W. Sheppard, Esqrs.

Lent from Home Office.

H. Topham, S. R. Bennett, A. C. Lowe, G. O. Sumner, E. L. Meeklin, C. F. Hunter, W. H. Mead,
W. Turner, F. Bowen, A. A. Hepburn, C. H. Taylor, C. E. Plumbo, F. W. Cockshott, A. Fotheringham,
L. D. Hooper, H. T. Kingsdore, and W. C. Evans, Esqrs.

Under War Office.

Lieut.-Com. John A. L. Hay.
Lieut.-Com. Archibald O. Goulden (ret.);

Captain Nathaniel F. Trotman, R.N.A.

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The following gentlemen have been appointed for temporary service during the War :

J. L. Capes, H. Jackson, A. McPherson, and P. H. Coursey, Esqrs.

Superintendent Clerk...Thomas G. Anderson, Esq.
Deputy Superintendent Clerk...W. D. Daniels, Esq. (act.).
Assistant Superintendent Clerks...E. Morrison, R. W. Smith (act.), and J. Stevens (act.), Esqrs.
 1 Second Division Clerk, Dockyard Clerks (including Acting) First Grade 1, Second Grade 2, Third Grade 2,
 Temporary Clerks and Boys 43, Draughtsmen 7.

Superintendent of Ordnance Stores...Captain Barrington H. Chevallier, R.N. (retired).
Assistant Superintendents of Ordnance Stores...H. Fathens.

Frederick Ward (act.).

G. E. Woodward (act.), Esqrs.

Superintendent Clerk...A. McFarlane, Esq. (act.)

Naval Ordnance Store Officer...W. A. Mortimer (act.), Esq.

Deputy Ordnance Store Officers...T. W. Midmer (detached for Special Duty), W. H. Rowe (act.), N. Thomas, and W. Vaughan, Esqrs.

Assistant Ordnance Store Officers...J. A. W. Ballard (act.), G. C. Ousens (act.), W. B. Lylys (act.),
 G. H. Murray and A. T. Reed (act.), Esqrs.

Examiners of Naval Ordnance Work...W. D. Evans (act.), and 1, J. Payne, Esqrs. (act.)

- 1 Ordnance Depot Clerk, First Grade.
- 4 Ordnance Depot Clerks, First Grade (act.).
- 13 Ordnance Depot Clerks, Second Grade (act.).
- 6 Ordnance Depot Clerks, Third Grade.
- 7 Ordnance Depot Clerks, Third Grade (act.).
- 1 Illrd Writer.
- 13 Temporary Illrd Extra Clerks.
- 14 Temporary Women Clerks.
- 6 Boy Clerks and Boy Writers.

Acting Assistant Ordnance Store Officer...Sheffield...G. Swift, Esq.
Chief Analyst...Sheffield...John C. W. Lumfroy, Esq.

The following have been appointed for special temporary services :

Dr. C. Welzmann.

Dr. Ida S. Maclean, Dr. J. O. Gavrowsky, H. Davis, E. G. Bainbridge, and H. Spiers, Esqrs.

NOTE—Officers of the Naval Ordnance Department serving at Woolwich and at the Ports are not shown.

DEPARTMENT OF THE DIRECTOR OF TORPEDOES AND MINING.

Director of Torpedoes and MiningRear-Admiral The Hon. Edward S. Fitzherbert.
SecretaryPaymaster (act.) Paul S. Sulekland.

Assistant Director (T)

Captain Algernon H. O. Candy.

Assistant Director (M).

Captain F. Rhulley Litchfield-Spoer, D.S.O.

Assistant Director (P).....Captain Vernon H. S. Haggard.

Naval Staff.

CaptainClaude G. R. Brandon (ret.).
 Gordon C. Brauer (ret.)
 Bryan G. Godfrey-Faussett, O.V.O., C.M.G., (ret.).
CommanderEvan C. Bunbury.
 Geoffrey G. Candy.
 Thomas R. Florida.
 Malcolm K. Grant (ret.).
 Walter H. Rigg, D.S.O. (act.) (ret.).
 Gerard B. Riley (ret.).
 James S. C. Simmond.
 Frederick E. E. O. Schreiber.
 Carlton C. Sherman (ret.).
Lieut.-Commr.Berttram Vigne.

Appendix

<i>Lieutenant</i>	Patrick P. Coleman. Benjamin B. G. E. Jameson. Alfred J. Parkes.
<i>Eng. Commr.</i>	Charles J. M. Wallace.
<i>Ch. Gunner</i>	James Wood.
<i>Gunner</i>	Leonard Repton. Walter Thorogood. Walter F. Williamson.
<i>Civil Staff.</i>	
<i>Deputy Superintending Clerk</i> (act.)	} P. B. Couratin, Esq.
<i>Inspector of Mines and Mining</i> <i>Gear</i>	
	} W. Pearce, Esq.

AIR DEPARTMENT.

<i>Director of Air Services (Fifth Sea Lord)</i>	Commodore Godfrey M. Faine, C.B., M.V.O.
<i>Private Secretary</i>	Paymaster U. A. Shove.

<i>Naval Assistant</i>	Captain A. V. Vyvyan, D.S.O.
<i>Asst. Supt. for Airships</i>	Captain D. T. Norris.
<i>Armament Captain</i>	Captain A. J. Davies.
<i>Asst. Supt. for Engines</i>	Wing Commander (E) W. Briggs (act.)
<i>Personnel Captain</i>	Captain John D. Edwards, C.B.
<i>Personnel Commander</i>	Wing Com. R. C. S. Hunt.
<i>Captain</i>	Lord Dunboyne.
<i>Military Liaison Officer</i>	Lieut. J. E. Pike, R.F.C.

<i>Commander</i>	A. D. Warrington-Morris (act.).
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<i>Wing Commanders.</i>		
J. L. Forbes.	A. Ogilvie.	Francis Ranken (act.).
A. M. Longmore.	C. R. J. Randall.	H. L. Woodcock.
J. D. Mackworth.		
<i>Squadron Commanders.</i>		
P. E. T. Howlett.	T. D. Mackie.	The Master of Sempill.
D. H. Hyde-Thomson.	C. E. Maude.	
<i>Flight Commanders.</i>		
J. Bird (act.).	P. H. Dunning, D.S.O.	W. O. Michie.
F. A. Brook.	J. I. Harrison.	E. J. O. Roberts.
F. G. Brodribb.	T. Hinchelwood.	S. V. Sippe, D.S.O.
G. W. Crandall.	F. W. Lucas.	M. B. Tomlinson.

<i>Engineer-Lieutenants</i>	R. Stanmore. W. A. O. Sandford-Thompson.
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<i>Flight Lieutenants.</i>		
C. T. Freeman, D.S.O.	L. J. Killmayer.	R. A. Reid.
D. M. B. Galbraith, D.S.O.	G. V. Leather.	F. W. Strong.
P. A. Johnston.	R. F. S. Leslie.	M. R. A. Wright.

<i>Flight Sub.-Lieut.</i>	T. P. M. Alexander.
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<i>Warrant Officers (1st grade).</i>
F. W. Scott.

<i>Warrant Officers (2nd Grade).</i>		
L. C. Abbott.	W. T. Curtis.	J. S. Mathias.
G. H. Brown.	A. Denkin.	C. Y. Mitchell.
J. B. Galt.	J. Hobbs.	J. H. Ormsby.
J. V. Collins.	H. J. Cooper.	A. B. Redstone.
H. G. Cooper.	C. Layzell-Apps.	W. G. J. Wardle.

<i>Commander R.N.V.R.</i>
G. Holmes.

<i>Lieut.-Commanders, R.N.V.R.</i>		
T. B. Barrington.	C. W. Gamble.	T. A. Monckton.
W. A. Bristow.	R. W. Hogarth.	F. C. H. Sinclair.
J. Craig, Esq.	C. F. Jenkin.	P. C. Williams.
Lord Eskine.	A. Landells.	M. B. Wimpels.
J. M. Fraser.	G. McAlpin.	

Lieutenants, R.N.V.R.

C. R. Abbott.
M. H. P. Allen.
C. R. Andrews.
J. Arthur.
F. A. Baldwin.
T. M. Barlow.
W. O. Bentley.
A. L. Bligh.
J. P. Bourke.
J. B. Buchanan.
F. A. Bumpus.
W. Binkinslaw.
E. E. W. Butt.
G. Caird.
J. D. Carmichael.
B. C. Carter.
E. H. Cockshott.
J. G. T. Crawford.
G. Crawley.
J. K. Cuiwon.
C. R. D'Arcy.
F. R. E. Davis.
H. Dodd.
J. G. Dothia.
A. J. Dronsfield.
J. P. Elsdon.
A. T. Evans.
H. Eves.
J. B. Falkner.
A. W. Farrer.
H. J. V. Hill.
S. Flower.
P. Garton.
A. S. Gendie.
H. D. N. Gilmora.
R. S. Geddard.

D. Gordon.
G. M. Gordon.
W. C. Grant.
J. E. A. Grestorox.
J. W. Griggs.
Hon. L. G. Guest.
B. E. Hamilton.
G. Haseleton.
J. F. Hedley.
S. R. Hill.
E. Hogg.
T. O. B. Hooke.
W. H. Jordan.
H. G. Horne.
E. O. Horsley.
H. Howard.
D. C. M. Hume.
A. J. Hurst.
A. G. Ionides.
W. B. Jones.
O. Kent.
W. A. Lawrence.
H. B. Leach.
G. W. Lester.
O. Lightfoot.
A. R. Low.
W. L. Maish.
J. J. Meakin.
S. R. Muldard.
C. J. Murfill.
G. H. Murphy.
G. C. Nelson.
T. F. Norbury.
T. L. Oliver.
A. Orr.
T. A. Parker.

A. R. Penn.
R. M. N. Perko.
W. E. Plaster.
F. R. Pollard.
W. J. Polybank.
O. H. Powell.
L. S. M. Pyke.
A. P. Reed.
G. M. T. Rees.
J. D. K. Restler.
F. B. Rigby.
A. Robertson.
E. C. St. John.
E. S. Saunders.
J. C. Savage.
K. Seccolan.
H. Shaw.
G. G. Shepherd.
H. G. Shire.
N. Sladden.
O. A. Slater.
A. F. H. Smallpiece.
F. H. Spragg.
J. E. Steele.
C. Suckling.
F. J. H. Summer.
O. A. W. Taylor.
A. K. Tomlin-Smith.
F. F. Turner.
S. H. Udale.
E. O. Walker.
H. N. Warburton.
A. H. White.
W. S. Whitelaw.
H. C. Woodward.

Sub-Lieutenants, R.N.V.R.

J. G. M. Bevan.
N. C. Blake.
S. D. Clarke.
O. A. Crow.
W. B. Daniels.
A. L. Davis.
P. M. Dawson.
T. A. Ellis.
J. D. Greenwood.

T. H. Harkness.
G. A. Harrison.
H. H. Haworth.
E. A. Hoghton.
A. H. Horsfield.
C. R. Lynn.
J. T. Matthews.
R. H. Methold.
M. J. H. Molyneux.

A. D. Newbury.
G. C. Pugh.
H. H. Pollett.
H. G. R. Rees.
W. B. Sinclair.
T. M. Wilson.
N. H. Wood.
O. H. Wright.

Asst. Payms. R.N.R.

S. B. F. Carter.

G. F. Green.

Civil Staff.

*Deputy Superintending Clerk...*R. W. Gilpin, Esq.
*Chief Examiner...*J. H. Jones, Esq. (act.).
(Lent from Inland Revenue.)
*Examiner...*C. R. Pledger, Esq. (act.).
(Lent from Inland Revenue.)
*Inspector of Aircraft Armament...*R. D. Dow, Esq.
2 Minor Staff Clerks (act.).
4 Second Division Clerks (2 serving with Army).
3 Assistant Clerks (1 serving with Army).
1 Extra Clerk, 1st Class.
1 Temp. Accountant Clerk, 1st Class.

2 Asst. Inspectors of Aircraft Armament.
31 Temporary Clerks.
Improvers.
3 Temporary Women Clerks, Higher Grade.
73 Temporary Women Clerks.
7 Boy Clerks.
*Civilian Technical Assistant...*Harris Booth, Esq.
*Asst. Technical Adviser...*H. Balas, Esq. (temp.).
F. E. Cowlin, Esq.
H. B. Howard, Esq.
A. J. S. Phippard, Esq.
9 Draughtsmen.

The following have been appointed for temporary service during the War :

Major L. N. G. Filton, R.N.S.

A. Berry, Esq.

NOTE.—The Officers of the Royal Naval Air Service and of the Air Stations are not shown.

(C) ADMIRALTY, END OF DECEMBER, 1917.

First Sea Lord and Chief of the Naval Staff.....Admiral Sir Rosslyn E. Wemyss, K.C.B., C.M.G., M.V.O.

THE NAVAL STAFF.

Deputy Chief of the Naval Staff.....Vice-Admiral (act.) Sir Henry F. Oliver, K.C.B., M.V.O.

Assistant Chief of the Naval Staff.....Rear-Admiral Alexander J. Duff, C.B.

Deputy First Sea Lord.....Rear-Admiral George P. W. Hope, C.B.

Secretary to A.O.N.S......Fleet Paym. (act.) John D. M. Cavanagh.

Staff Clerk.....W. L. Hancock, Esq. (act.).

OPERATIONS DIVISION.

Director of the Operations Division (Home).....Captain A. D. P. Pound.

Deputy Director of the Operations Division.....Captain Henry W. Grant, C.B.

Assistant Directors of the Operations Division.....Captain Charles P. H. Coodie, D.S.O.

Lieut.-Col. Walter T. G. Jones, D.S.O., R.M.L.I.

Naval and Marine Staff.

Captain ... A. G. Allgood (ret.).

A. F. Boul.

R. P. Clutton (ret.).

C. G. H. Eeles (ret.).

Ocell H. Fletcher.

Commander Charles D. Roper (temp.).

Kenneth (S. B. Dewar).

F. Bowden-Smith (ret.).

S. V. R. C. Messum (ret.).

T. W. Stirling (emera.).

Leonard Robinson (act.).

Commr. J.L.R. Duke of Sutherland.

Wing. Commr. Hugh A. Williamson.

Lieut.-Com. Hon. Joseph M. Kenworthy (temp.).

Maj. & Bt.Lt. } *Michael Stephen J. F. French.*

Col. R.M.A.

Lieut.-Com. J. P. Gibbs.

Lieut.-Com. } Herbert Ingram.
R.N.V.R.

Lieut.R.N.V.R. Sidney T. Morris.

Harold I. Dear.

Charles F. Yeomans.

Leonard E. Lander.

Wilfred A. Johnson.

Thomas C. Spurway.

Flt. Sub-Lieut. Stanley F. Ingram.

Sub-Lieut. } Cyril S. Goddard.
R.N.V.R.

Asst. Paym. } Frank J. Magee.
R.N.V.R.

Civil Staff.

Staff Clerk...P. R. Bailey, Esq. (act.).

2 Second Divisions Clerks.

1 Confidential Shorthand Writer.

11 Assistant Clerks.

2 Accountant Clerks.

3 Extra Clerks.

PLANS DIVISION.

Director of Plans.....Rear-Admiral Roger J. D. Keyes, C.B., C.M.G., M.V.O., D.S.O.

Assistant Directors of Plans.....Captain Cyril T. M. Fuller, C.M.G., D.S.O.

Captain Godfrey F. Orde, R.M.L.I.

Naval Staff.

Commander James S. McL. Ritchie.

Alfred F. B. Carpenter.

Lieutenant Charles W. L. Maynell.

Civil Staff.

Staff Clerk...A. Backhouse, Esq. (act.).

Additional Officers borne temporarily for the Naval Staff were shown in the November "List" under "President."

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Captain ... William M. James.	Adj. & Hk. } Frank V. Tenplo, R.M.L.I.	Lieut. } Benjamin S. F. R.N.V.R. } Phillips.
Commander Vivian T. Brandon.	Lt.-Col. } Percy E. Heycock, R.M.A.	Neville Forbes.
Francis G. G. Chilton.		Burton S. R. Cope.
Colpoys G. Walcott (ret.).	Major Walter Sinclair, R.M.L.I.	F. D. Heazley.
Morris E. Cochrane, D.S.O. (ret.).	Donald M. Trench, R.M.L.I.	E. C. Quiggin.
Godfrey B. Sploor- Slusson, D.S.O.	Arthur Peel, R.M.L.I.	G. S. Rawson.
Walter O. Lucas, (Staff Officer 2nd Grade).	(Staff Officer 2nd Grade).	Desmond
Alfred G. Downe (ret.).	Cecil E. S. Wright, R.M.L.I.	MacCarthy (unpaid).
H. O. Orme-Webb.	Charles B. Mullins, R.M.L.I.	Harold G. S. Dillon.
Commander } Lord Hirschall, R.N.V.R. } R.U.V.O.	Capt. J. C. Farmer, R.M.L.I.	Reynolds J. Hope.
Hon. William Cuzens-Hardy, K.C.	Lieut. Edward S. Williams.	Charles W. L. Manby.
C. P. Serocold	Andrew H. M. Haggerd.	Walter H. Buford.
R. J. B. Hippisley.	F. D. Belfield (act.).	Herbert T. Sullivan.
George G. Nady.	Lieut. } Arthur E. Watts. R.N.V.R. } F. Homer.	Lieut. R.M. } Frank E. Bowen. (Res.)
Commander } Norman Craig, K.C., R.N.V.R. } M.P.	Hyde Kennard.	Naval Ensign. Guy V. Rayment, D.A.
D. C. Caldwell (act.).	Frank C. Thinks.	Fleet Paym. Charles J. E. Roiter on.
A. C. Denniston.	Frank Birch.	Ernest W. O. Thring
W. Dudley Ward, M.P.	A. F. Stovenimon.	William H. Evans.
H. F. Wood.	Henry M. Howard.	Staff Paym. John N. Fletcher. Lloyd Lister (act.).
H. Pagel.	A. D. Knox.	Staff Paym. } Cyril Cox. R.N.R.
Coall N. R. Wright.	H. Hanson.	Sub-Lieut. } J. Simson. R.N.V.R. } Sam B. Williamson.
J. A. Gardner (temp.).	H. C. J. Green.	Asst. Paym. } E. Foster. R.N.R.
Lieut.-Com. Walter T. Bagot.	E. Bulloagh.	J. P. Loughnan.
Arthur W. Wood (ret.).	G. L. N. Hope.	Asst. Paym. } William H. R.N.V.R. } Osman.
Roger V. do Hialbert (ret.).	L. A. Willoughby.	William Cavthera.
	Donald E. Wex.	F. J. L. Robertson.
	Dudley F. N.	P. R. Swanton.
	Fitzgerald.	
Asst.-Com. } F. E. Adcock. R.N.V.R. } N. de Grey.	Frederick S. Le B. Smith.	Schnur. } Frederick Bush. Lieut. (act.).
James Randall.	John P. Curwen.	Midshipman George H. Carbut.
Eng. Com. Percy Vileator.	Benz B. Bond.	
	Herbert A. Morrah.	
	Douglas I. Suvory.	

Staff Clerks— Hugh Broadbent, Esq.	Cartographer— O. Beikenden, Esq. 4 Second Division Clerks. 1 Confidential Shorthand Writer.	1 Assistant Clerk. 7 Temp. Clerks. 1 Supervising Asst. Clerk (act.). 4 Boy Clerks, 70 Women Clerks. 10 Draughtsmen.
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W. T. Ansley, M.A. (*Leit from Dartmouth College*), Esq., Sir P. W. Baker-William, Bt., LL.B., J. V. Baelcomb, Lt. R. B. Boulton, Esqrs., 2nd Lieut. R. N. Rudmore Brown, Lieut. Calder, A. Orell, B. Russell Clarke, C. S. Cooke, C.M.G., Esqrs., Hon. G. Colville (*unpaid*), Lieut. Mickle, H. N. Dickson, M.A., D.Sc., C. B. R. Idlis (*Leit from Local Cook Board*), Esqrs., C. H. Fitzmaurice, Esq., C.M.G., H. R. Ford, Esqrs., 2nd Lieut. W. L. Fraser, J. W. Goudwin, A. C. Grant Duff, Cecil Hambury (*unpaid*), Esqrs., Miles H. Haines (*unpaid*), Capt. E. H. Handley, 2nd Lieut. E. L. Hobson (*London Regt.*), G. W. C. Hunt, Esq., Lieut. J. H. Inskip, Lt.F.C., T. W. H. Inskip, M.C., H. W. Lawrence, Esqrs., 2nd Lieut. S. S. G. Lesson, R. Lewis, Esqrs., Capt. Lock, Major J. J. Luard (*Indian Army ret.*), The Earl of Lytton, Capt. L. I. Molyneux, Lord Monk-Bretton, C.B., Rev. W. C. Montgomery, M.A., Miss Max Muller (*unpaid*), R. Nevill, R. D. Norton, Esqrs., Rev. W. C. Oesterley, 2nd Lieut. Col. Capt. R. F. Ould, G. W. Prothero, H. Rackham, M.A., H. Russell, M.C. O. Trench, Esqrs., Capt. H. D. Usher, Lieut. V. N. B. H. Vincent, L. Vaughan-Williams, M.C. (*unpaid*), C. Young, M.V.O., Esqrs.

Appendix

TRADE DIVISION.

<p>Director of Trade Division... Captain Alan G. Notham. <i>Acting Assistant Director of Trade Division... Captain Francis W. Longden, C.M.G.</i> <i>Secretary to D.T.D.... Staff Paym. John Siddalls.</i></p>	
<p><i>Captain</i> W. D. II. Margesson (ret.). T. U. Foster, (ret.). Philip Walter (ret.). Reginald L. Crichton (ret.). <i>Commander</i> Maxwell R. Anderson (act.) (ret.). William C. Custie (act.). Edward B. Compton (ret.). Sir Charles L. Gust, <i>2d. K.C.V.O.</i>. <i>C.B., C.M.G., C.I.D. (ret.).</i> Oscar V. do Matos (ret.). Thomas Fisher. Walter P. Koo (ret.). Andrew L. Marquis. A. H. Christian, <i>M.V.O. (emerg.)</i>. Francis G. Vaughan (temp.). Henry de B. Pupper (temp.). Robert C. Wilson, <i>M.S.O.</i>. <i>Lieut.-Com.</i> { William Gorman. <i>R.N.V.R.</i> { W. J. Arnold-Foster (temporarily detached). <i>Lieut.</i> { Hugh C. Arnold-Foster. <i>(Emerg.)</i> { <i>Lieut. R.N.R.</i> W. II. Stewart.</p>	<p><i>Lieut.</i> { F. H. McCormick-Goodhart. <i>R.N.V.R.</i> { F. McCormick-Goodhart. John B. D. Jock. Jongens A. Lang. Arthur M. Fieldon. John McK. Robertson. <i>Eng. Com.</i> ... Henry C. Rush (ret.). <i>Lieut.-Col.</i> ... Thomas H. Hawkins, <i>O.M.C., R.M.L.I.</i> <i>Fleet Paym.</i> Graham Howlett. <i>Staff Paym.</i> Cunningham Pior. William R. Scotland. <i>Staff Paym.</i> { Harold B. Tullill. <i>R.N.R.</i> { W. A. J. Boxford (act.). <i>Sub.-Lieut.</i> { Henry J. R. Maitland. <i>R.N.V.R.</i> { Alexander B. Mallison. Arthur Bright-Smith. <i>Asst. Paym.</i> { Joseph H. Wilson. <i>R.N.R.</i> { <i>Asst. Paym.</i> { Sholto G. Douglas. <i>R.N.V.R.</i> { Hugh S. Kingford. Frederick J. J. Shilley.</p>
<p>2 Second Division Clerks. 1 Accountant Clerk (ret.). 2 Clerical Assistants.</p>	<p><i>Civil Staff.</i> 15 Temporary Clerks. 2 Boy Clerks. 3 Higher Grade Women Clerks. 35 Women Clerks.</p>

The following have been appointed for temporary service during the War :

<p>H. S. Moss Rhindoll, Esq., <i>C.B., C.I.D.</i>. <i>1st. (unpaid).</i> Sir Frederick Bolton (unpaid). H. Hurm-Tyso, Esq. (unpaid).</p>	<p>Mrs. C. H. Campbell (unpaid). H. O. Oumherbath, Esq. (un- paid). Allen Deacon, Esq. (unpaid).</p>	<p>J. J. Fenton, Esq. G. D. Dardino-Tyler, Esq. W. W. Harrington, Esq. (unpaid). J. Heron Lepper, Esq.</p>
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SIGNAL DIVISION.

Acting Director of Signal Division... Commander... Richard T. Nicholson, D.S.O.

<p><i>Lieut.-Com.</i> Gerald H. Villiers. <i>Lieut.</i> Francis P. O. Bridgeman. Frederick W. Boswell. <i>Lieut. R.N.V.R.</i> W. Clavolant-Stevens. Frederick W. Attonbury. Isabel W. Hunkingdon. <i>Major R.M.A.</i> Stephen C. Wace. <i>Capt. (act. Major) R. M. Edward Chillesslo, D.S.O.</i> <i>(Staff Offr. 2 Grade)</i> <i>Fleet Paym.</i>... John M. A. Brown (act.). <i>Staff Paym.</i> John L. Symon. Alexander C. Homo (act.). Edward W. H. Travis (act.). George H. Russell (act.).</p>	
<p>6 Elected Extra Clerks.</p>	<p><i>Naval Staff.</i> <i>Paym. R.N.R.</i> John W. Sells, <i>D.S.O. (act.)</i>. <i>Sub-Lieut. R.N.V.R.</i> Brian Rhys. William G. Phelps. Gordon C. Young. John R. N. Charter. Laurence C. Robinson. Harold B. Farnell. William C. Willmot. James L. A. Huggan. John L. P. Lamlie. <i>Wt. Telos.</i> ... John R. Barnes. <i>Wt. Writer</i>... John G. Attenwell (act.). 2 Chief Writers (1 paid).</p>
<p>154 Women Clerks.</p>	

ANTI-SUBMARINE DIVISION.

<p>Director of the Anti-Submarine Division Captain William W. Fisher, <i>M.V.O., R.N.</i> <i>Assistant-Director of the Anti-Submarine Division</i> Captain Claude Sermour, <i>D.S.O., R.N.</i> <i>Secretary to D.A.S.D.</i> Staff Paym. (act.) Marcus Blake.</p>	
<p><i>Captain (act.)</i> A. M. Yeats-Brown, <i>D.S.O.</i> <i>Command'r</i> ... John W. Carrington, <i>D.S.O.</i> George B. Lewis. Edward H. Russell. Isabel H. Hordern. Lawson G. B. A. Campbell, <i>M.S.O.</i> Henry L. Hitchens.</p>	<p><i>Lieut.-Com.</i> ... Archibald M. Willoughby (emerg.). <i>Lieut.-Com. R.N.V.R.</i> Louis C. Bonacchi (act.). Tacy M. W. Wallis (act.). <i>Lieutenant</i> ... Anthony H. Donley. Colin A. G. Hutchinson (temp.). <i>Lieut. R.N.V.R.</i> William L. Preece. Henry V. M. Harsard. Cecil A. V. Roper. Pakenham W. A. H. M. Beatty. Donald H. Morris. <i>Staff Paym. (act.)</i>... Gordon Franklin. <i>Sub-Lieut. R.N.V.R.</i>... Paul McG. Moffat.</p>
<p><i>Eng. Captain</i> Henry W. Mekanlo (ret.). <i>Eng. Com.</i> ... Edgar W. Riley. <i>Temp. Eng. Lieut.-Com.</i> Thomas Orr (act.). <i>Lieut.-Com.</i>... Stephen S. English.</p>	

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Civil Staff.

Staff Clerk.....	W. G. Johns, Esq. (act.).
	W. R. Hale, Esq. (act.).
1 Clerical Assistant.	0 Women Clerks.
6 Temporary Clerks.	2 Boy Clerks.

MINESWEEPING DIVISION.

Director of Minesweeping.....	Captain Lionel G. Preston, C.B.
Captain (act.) Harry F. Cayley, D.S.O. (ret.)	(Liaison Officer).
Commander Henry M. J. Rundle (act.).	Lieutenant Charles H. Powell, R.N.V.R.
Lieut.-Com. Graham C. Glen, D.S.O.	Gerald M. Morse, R.N.V.R.
Thomas C. MacGill.	Staff Paym. Reginald B. Ford (act.), R.N.R.
2 Temporary Clerks.	2 Women Clerks.

MERCANTILE MOVEMENTS DIVISION.

Director of Mercantile Movements...	Captain Frederic A. Whitehead.
Secretary...Staff Paym. (act.)	Paul S. Strickland.
Captain Bertram H. Smith (ret.).	Staff Paym. John M. Hodge.
Captain H.A.N. George F. Hyde.	Asst. Paym. R.N.R. Philip K. Hutchinson.
Commander Hinch D. Mullenoux.	Asst. Paym. R.N.V.R. Robert W. Carroll.
John Kiddie.	Robert P. White.
Cuthbert D. Longstaff.	J. Robbins.
Commander R.N.R. Herbert W. Kenrick, R.N. (ret.).	Robert H. B. St. John.
Lieut.-Com. Claudio B. Evans.	Hubert G. Hickman.
Lieut.-Com. R.N.R. Cecil E. Pilkington.	Thomas Sherratt.
Lieutenant R.N.R. James R. Harding.	N. A. Leslie, Esq.
Lieutenant R.N.V.R. Frederic O. Lidstone.	
Sub-Lieut. R.N.V.R. Philip S. Knowles.	
Fleet Paym. H. W. Eldon Manly, C.M.G.	Captain Herbert M. Edwards.
(Organising Manager of Convoys.)	Commander Frederic G. S. Pelle.
Commander Ronald G. L. Owen (ret.).	
Commander R.N.V.R. Henry D. King, D.S.O., V.D.	
Rollo Appleyard.	Captain ...Cathart R. Wason, C.M.O. (Captain of Naval Tugs).
Lieut.-Com. John O. Wyatt (ret.).	Commander...Hartley R. G. Moore.
Lieutenant Geoffrey E. Burton.	Norman B. Youal (ret.).
Lieutenant R.N.V.R. Hubert M. Medell.	Staff Paym.....Eyre S. Duggan (act.).
Geoffrey F. Gilbert.	
Alan P. Herbert.	
1 Minor Staff Clerk, 6 Temporary Clerks, 1 Boy Clerk, 12 Women Clerks.	

TRAINING DIVISION.

Director of Training...Rear-Admiral James C. Ley, O.V.O.

MATERIEL DEPARTMENTS.

DEPARTMENT OF THE DIRECTOR OF NAVAL EQUIPMENT.

Director of Naval Equipment...	Captain Edward M. Phillips, C.B., A.D.C.
Assistant Director of Naval Equipment...	Captain Humphrey T. Walwyn, D.S.O.
Captain	Alexander Farrington.
	Lieut. R.N.R., Arthur F. Croxford.
Claudio G. R. Brandon (ret.).	Lieut. } Norman Wilkinson (temp.).
Commander ...George H. H. Holden (ret.).	R.N.V.R. } Charles Thomas (temp.).
Frank F. Rose, D.S.O.	C. Payno (temp.).
Sydney B. Boyd-Richardson.	Hubert A. Youkney.
Alick Stokes.	Cecil King.
Edmund L. B. Lockyer, D.S.O.	Oswald R. Moser.
(ret.) (act.).	Engineer Capt. Henry R. Teed (ret.).
Commander .....Lewis G. B. Grabbe.	Carp. Lieut. ...Thomas L. Soper.
Lieut.-Com. } John W. Williams, D.S.O.	Carpenter .....Joseph S. Legg.
R.N.R.	
1 Dockyard Clerk, 2nd Grade. 1 Higher Grade Woman Clerk. 15 Temporary Women Clerks.	
2 Modellers. 1 Woman Modeller.	

Appendix

SALVAGE SECTION.

Assistant Director of Naval Equipment (for Salvage)...Captain Christopher P. Motenliffe, D.S.O. (ret.).
Commander ... James H. Dabhan (ret.). *Staff Paym. ... Arthur W. B. Messenger.*
 3 Women Clerks.

Salvage Officers.

Commander } *James W. Gracoy (act.).*
R.N.R. } *Ivo J. Kay (act.).*
Charles K. Boissaw (act.) (tempy.).
(Ind. as Chief Salvage Officer
in Mediterranean).
George J. Wheeler (act.) (tempy.).
Commander } *Herbert R. Mallet (act.) (tempy.).*
R.N.V.R. } *David W. Matlinho (act.) (tempy.).*
Assistant Salvage Officers—
Lieut.-Com. Guyton C. C. Hannum (ret.).
(Tempy. Assistant Salvage
Officer).

Lieut. R.N.R. ... George Davis (tempy.).
James O. Ingram (act.) (tempy.).

Lieut. R.N.V.R. Cecil H. Blashopp (tempy.).
Albert M. George (tempy.).
John M. McQueen (tempy.).
John M. F. Hilmay (tempy.).
James Smith (tempy.).
Harvard L. V. Jones.

Eng. Lieut. Joseph H. Vino (act.) (tempy.).

Eng. Lieut. Charles F. Smith (tempy.).

Naval Salvage Adviser...F. W. Young, Esq., M.I.M.E.

Superintendents of Contract-built Ships—

Rear-Admiral John F. M. Green, C.B., { *For Contract Work (not including Destroyers) on the*
(Tyne
Address—Broomhall, Broomhill Drive, Partick, Glasgow
Rear-Admiral Alfred R. A. Grant { *For Contract Work (not including Destroyers) on the*
Tyne, Thames, Mersey, at Darrow-in-Furness, and
at Sunderland.
Address—4, Osborne Villas, Osborne Avenue, Newcastle-
on-Tyne.

Captain Superintendent of Torpedo Boat Destroyers building by Contract.
Captain Cyril Anser. Address—47, Victoria Street, S.W.1.

DEPARTMENT OF THE CONTROLLER.

Controller...Sir Alan Garrett Anderson, K.C.B.
Civil Assistant...J. A. C. Champlion, Esq.

Secretariat.

Secretary...L. R. Hoath, Esq., C.S.I., Assistant Secretary of the Admiralty (act.).

Principal Clerk...J. B. Abraham, Esq. (act.).

Assistant Principal Clerks...S. T. Blackwell, Esq. (act.).

J. A. C. Champlion, Esq. (act.).

G. W. Lovett, Esq. (act.).

Staff Clerks...H. J. Tozer, Esq., Alfred Wotton, Esq. (act.).
 2 Acting Minor Staff Clerks, 2 Second Division Clerks, 1 Acting Second Grade, 1 Acting Third Grade
 Dockyard Clerks, 18 Tempy. Clerks, and 38 Women Clerks.

The following have been appointed for temporary services during the War:

A. C. Clauson, K.C. (unpaid), and A. Gilbert, Esqrs.

DEPARTMENT OF THE DIRECTOR OF NAVAL CONSTRUCTION.

Director of Naval Construction...Sir Isaac H. Tunnyson D'Ernecourt, K.C.B.

Deputy Director of Naval Construction...W. H. Gard, Esq., C.B., M.V.O. (act.).

Assistant Directors of Naval Construction...T. Dally, Esq. (act.) (Superintendent of Naval
Construction), A. W. Johns, Esq., (act.), J. H. Norbeth, Esq., M.V.O. (act.),
H. Pledge, Esq., A. E. Richards, Esq.

Superintendent of Admiralty Experiment Works...R. B. Froude, Esq., O.B., L.D., F.R.S.

Chief Constructors.

H. L. Atwood (act.). *C. W. Knight (act.).*
S. B. Boyland (act.). *O. F. Munday (act.).*
F. Bryant (act.). *O. A. Payne (act.).*
A. J. Holson (act.). *P. L. Dethick, Esqrs.*

Constructors.

C. A. Busscott (act.). *F. M. Lee (act.).*
(Overseeing). *G. S. Lillcrop (act.).*
C. M. Carter (act.). *W. J. Martin.*
E. B. Chasls (act.). *T. L. Mathias (act.).*
C. H. Child (act.). *P. L. Mayer (act.).*
S. V. Goodall (act.). *M. J. Macyon (act.).*
(Tempy. detached). *(Overseeing).*
C. Hearnford (act.). *A. Nicholls (act.).*
E. B. Harries (act.). *W. G. Sanders (act.).*
F. Hickey (act.). *A. W. Watson (act.).*
C. J. W. Hopkins (act.). *L. C. Williamson (act.).*
A. H. Horley (act.). *T. Woolard (act.).*
C. W. Kerridge (act.). *Esqrs.*

Assistant Constructors, First Class.

T. H. Bentley *G. Mackay*
(Overseeing.) *(Overseeing.)*
A. Cannon *W. R. Noble*
(Overseeing.) *(Overseeing.)*
E. S. Gurfhey *R. P. Doherty*
(Overseeing.) *F. C. O. Rogers.*
W. Froude (Master). *W. H. Wallond, Esqrs.*

Assistant Constructors, 2nd Class.

G. MacCloughrie. *V. G. Shephard.*
R. J. Monk. *S. N. Thovan.*
J. M. P. Moon. *K. H. Wakham, Esqrs.*
F. C. O. Rogers.

Temporary Assistant Constructors.

A. G. Alcester, B.Sc.	D. A. Arkley, B.Sc.	A. R. Kimberley.	K. J. A. Pound.
J. Angus, B.Sc.	J. L. Davies.	M. M. Parker.	P. G. Rouse, B.A.
C. W. Blou, B.Sc.	D. L. Evans, B.Sc.	G. McL. Paterson.	J. T. Sowden, B.Sc.
H. L. Champness, B.Sc.	T. Graham, B.Sc.	A. P. Patterson, B.Sc.	T. B. Sowden, B.Sc.
F. O. Cocks.	W. H. Hockaday.		J. C. M. Wilson, Esqrs.

Temporary Acting Assistant Constructors.

G. Chaud.	W. L. Taughton.	A. F. Perkins.	S. F. Thorn.
J. B. Clark.	P. J. Parmlter.	H. Philpott.	A. Worren.
W. H. Bastcott.	G. B. Penoli.	F. Skeens.	G. L. Whiteway, Esqrs.
G. Dimulsett.	G. Pomey.	A. Taylor.	

*Temporary Assistant... R. W. Dana, Esq., M.A.
 Inspecting Officer of Smiths' Work... J. T. Pearson, Esq.
 Curator of Drawings... W. J. Moore, Esq.
 Confidential Clerk to D.N.C.... J. Saffman, Esq.
 Technical Clerk to D.N.C.... W. H. Malpas, Esq.
 60 Principal and 235 Assistant Overseers.*

27 First Class and 114 Second Class Draughtsmen, 1 First (acting) and 1 Third Grade Dockyard Clerks
 10 men and 17 Women Typists and Clerks, 1 Boy Clerk, 4 Modelists, and 2 Sumpsters.
*Superintending Electrical Engineer... C. H. Worthingham, Esq., M.I.C.E., M.I.M.E., M.I.E.E.
 Electrical Engineers, Higher Grade... A. D. Comtable, M.I.C.E., and E. T. Williams, M.I.M.E. (act.), Esqrs.
 Electrical Engineers.—H. Melville Ackery, M.I.C.E., J. S. Beddoe, A.M.I.E.E. (act.), F. P. Fletcher,
 A.M.I.C.E., A.M.I.E.E. (act.), F. O. Forster, M.I.E.E., W. P. Scott, A.M.I.E.E. (act.), and R. Wightman, Esqrs.
 First Assistant Electrical Engineers... W. H. Chatten (act.), H. H. R. Green, A.M.I.E.E., and J. Shaw,
 A.M.I.E.E. (act.), Esqrs.
 Temp. Asst. Electrical Engineers... F. Morton, A.M.I.E.E., and R. W. Wills, A.M.I.E.E., Esqrs.
 Second Assistant Electrical Engineers (act.), 8 First Class, 7 Second Class, and 5 Temporary
 Draughtsmen, 6 Temporary Clerks, 5 Women Clerks and 2 Boy Clerks.*

DEPARTMENT OF THE ENGINEER IN CHIEF.

Engineer-in-Chief of the Fleet... Eng. Vice-Admiral George G. Goodwin, C.B.

Deputy Engineer-in-Chief and Superintendent of Naval Engineering—

Eng. Rear-Admiral Edmund (undin).

Assistant Engineers-in-Chief (Eng. Captain Charles W. J. Dearblock (temp.).

Eng. Captain Edward A. Short (ret.) (temp.).

Engineer Inspectors.

Eng. Captain... David J. Carruthers.

Eng. Commander... Frederick W. Marshall.

Arthur E. Hynes.

Joseph J. Kirwin.

Lionel M. Hobbs.

John Hamilton.

Thomas G. Proctor.

William S. Mann.

Robert Deaman.

James F. Shaw.

Engineer Commanders.

James J. Sargent.

Jesse H. Harrison.

Ernest Nibbs.

Engineer Lieutenant-Commanders.

Yarham W. Knott.

Frederick J. Pedrick.

Walter W. Lock.

Harold B. Tustevin, D.S.O.

George W. Odani.

Edwin F. St. John (ret.).

Harry H. Carter.

John S. Orr.

Edwin Williamson.

Lawrence Turner.

Eng. Lieut.-Commander... Stanley C. Church.

Engineer Lieut... Brian J. H. Wilkinson.

Civilian Engineer-Overseers... W. Letty and M. Ord, Esqrs.

Inspector of Dockyard Work... E. Fage, Esq. (act.).

Examiners of Engineering Accounts... T. J. Hartnell (act.) and J. E. W. Littleley (act.), Esqrs.

10 1st Class Draughtsmen, 21 2nd Class Draughtsmen, 14 Temporary Draughtsmen,
 8 Dockyard Clerks, 1 1st Writer, 5 Temporary Clerks, 2 Extra Clerks, 22 Women
 Clerks, 2 Boy Clerks.

DEPARTMENT OF THE DEPUTY CONTROLLER FOR DOCKYARDS AND SHIPBUILDING.

Deputy Controller... Sir Thomas Bell, K.C.B.

Director of Dockyards and Repairs... Rear Admiral Laurence B. Power, C.B., C.V.O.

Deputy Director of Dockyards and Repairs... E. R. Bate, Esq.

Superintendents of Dockyard Branch—

Assistant Director of Dockyards and Repairs—

L. J. Webb, Esq.

Eng. Captain Robert B. Dixon, R.N.

Electrical Engineering Assistant... W. McClelland, Esq., M.I.E.E.

Secretary to D.C.D.S.... F. C. Routly, Esq.

Appendix

Manager, Constructive Department—
F. B. Mills, Esq. (temp.). (For special service.)

Chief Constructors—

(1. M. Apsey, Esq. (temp.).
C. H. Croxford, Esq. (act.) (temp.).
C. G. Hall, Esq. (act.) (temp.).

Constructors—

W. T. Davis, Esq. (temp.).
C. P. Ludford, Esq. (act.).
J. McQueen, Esq. (act.).
H. B. Wood, Esq. (act.).

For Special Service—

Rear-Admiral Robert Mayston, C.B. (ret.) (temp.).
Rear-Admiral Charles Rudd.
Rear-Admiral Albert H. Tompkins (ret.), R.N.
Rear-Admiral G. W. Murray (ret.), R.N.

Engineer Assistants—

Rear-Admiral Samuel P. Ferguson.
Rear-Admiral J. G. Budge.
T. R. Milvy, Esq. (Leit from Haulbowline Dockyard).
H. H. Langmuir, Esq.

Examiners of Dockyard Work—

T. H. Harth, M. A. Laker, J. D. Gibby (act.), J. Ellis, W. L. Cook, P. Gaultier, O. Howwood (act.), R. J. Fletcher (act.), J. A. Fage (act.), and J. H. Martin (act.), Esqs.

Electrical Engineer Higher Grade... T. Edge, Esq. (temp.).

Electrical Engineers... J. H. Bellue, A.M.I.E.E. (act.) and A. H. Franklin (act.), Esqs.

First Assistant Electrical Engineers... H. P. Blake (act.), E. L. Brain (act.),

J. Marcy (act.) and J. H. Ward (act.), Esqs.

Clerical Assistant... G. O. Stanbury, Esq. (act.).

Senior Visiting Inspector of Timber... W. H. Hooper, Esq.

Visiting Inspector of Timber... Alfred James, Esq.

3 Dockyard Clerks (First Grade), 4 Dockyard Clerks (Second Grade), 1 Senior Draughtsman,

6 First Class Draughtsmen, 14 Second Class Draughtsmen, 14 Dockyard Clerks (Third Grade),

3 Alfred Willers, 4 Temporary Clerks, 23 Female Clerks, and 9 Boys.

WARSHIP PRODUCTION SECTION.

LONDON STAFF.

Director of Warship Production... W. J. Barry, Esq., C.B.

Deputy Director of Warship Production... Engineer Captain J. G. Livesidge, R.N.

Assistant Director of Warship Production... E. A. Pearce, Esq.

Superintendent of Warship Production... W. H. Carter, Esq.

Senior Engineer Assistant... Engineer Captain P. D. Martell, R.N.

Senior Constructive Officer... J. A. Yates, Esq.

Superintendent of Warship Electrical Work... J. McCallery, Esq.

Secretary to Director of Warship Production... R. J. Wright, Esq.

Constructors... A. Adams (act.), G. Bulkley (act.), C. H. Goodyear, J. O. Joughin (act.),

H. F. Spanner (act.) and L. D. Stansfield (act.), Esqs.

Engineer Assistants... Engineer Commander W. A. Wilson, C.M.G., R.N.

Engineer Commander F. A. Gordon, R.N., W. J. Stallion (act.), Esq., W. G. Matthews (temp.), Esq.

Electrical Engineers... A. J. Toord (act.), A. Moore (act.), Esqs.

Assistant Constructors... W. Butlerwick (temp.), W. J. Craig, Esq., R. Fairley (temp.),

R. McMillan (temp.), D. E. J. Oxford, J. W. Westlake (temp.), Esqs.

Financial Inspectors... E. Cedyre, R. O. Knight (temp.), Esqs.

Engineer Inspectors (temp.)... R. N. Brown, G. Burton, L. H. Forsyth, W. A. Guthrie, Esqs., Lieut.

(L. W. Hill, D. A. MacFarlane, C. T. Johnson, T. H. Matthews, D. Hulseon, S. H. Warren, E. H. Pollett,

L. J. Nobbs, Esqs.

Inspecting Officer... W. C. Thomas (ret.), Esq.

First Assistant Electrical Engineers... C. R. Jowett (act.), C. H. Klyne (act.),

H. F. Kil (act.), Esqs.

Examiners of Accounts... E. H. Rogers (temp.), G. Taylor (temp.), and

W. B. Vanstone (act.), Esqs.

Assistant Examiners of Accounts... T. Batt (act.), J. Boulden (act.), W. Bray (act.), W. J. Case (act.),

F. G. Gay (act.), A. H. Halls (act.), S. W. H. Fippott (act.), G. H. Wilson (act.), Esqs.

2 Dockyard Clerks (act.) (First Grade), 4 Dockyard Clerks (Second Grade), 7 Draughtsmen,

2 Dockyard Clerks (act.) (Third Grade), 82 Temporary Clerks (female), and

14 Temporary Clerks (male).

OUTDOOR STAFF.

CLERKS.

Warship Production Superintendent... H. J. Mansford, Esq. (Address... 105, West George Street, Glasgow.

Deputy Warship Production Superintendent... F. W. Seale, Esq.

Warship Production Inspectors... A. C. Beard, T. J. Barry, J. Bryant, W. E. Head, W. T. Hoskin,

W. B. Hadden, Y. G. McCulloch, P. W. Rolison, Esqs.

Warship Production Inspectors (Engineers)... J. Appleby, W. Bagg, D. McMillan, M. Munro, Esqs.

TYNE.

Warship Production Superintendent...A. M. Worthington, Esq. (*Address*... 'Millburn House,' Newcastle-on-Tyne).

Deputy Warship Production Superintendent...J. Innes, Esq.

Warship Production Inspectors...E. J. F. Leatherby, J. J. N. Batey, A. S. Blatchford, A. E. Moore, J. W. Turner, J. Sampson, Esqrs.

Warship Production Inspectors (Engineers)...P. Cowe, J. Windlay, T. McBride, O. Stuart, Esqrs.

MERSEY.

Warship Production Superintendent...M. P. Dayne, Esq. (*Address*... 233, Royal Liver Buildings, Liverpool).

Deputy Warship Production Superintendent...P. Wright, Esq.

Warship Production Inspectors...W. J. Bunday, E. A. Cawden, H. W. M. Hamilton, T. M. Taylor, Esqrs.

Warship Production Inspectors (Engineers)...S. Gould, J. Howells, C. Verity, Esqrs.

LONDON AND SOUTHERN DISTRICT.

Warship Production Superintendent...J. W. Dippy, Esq., Admiralty (Block V.I).

MANCHESTER, SHEFFIELD, AND LEEDS DISTRICT.

Engineer Inspector...E. Anthony, Esq.

BIRMINGHAM, COVENTRY, AND LICHFIELD DISTRICT.

Engineer Inspector...H. H. Poteris, Esq.

3 Dockyard Clerks (Second Grade), 9 Dockyard Clerks (Third Grade).

DEPARTMENT OF THE DEPUTY CONTROLLER FOR AUXILIARY SHIP-BUILDING.

Deputy Controller.

Major-General A. S. Collard, C.B., R.E.

Director of Auxiliary Shipbuilding.

Deputy Director of Auxiliary Shipbuilding...A. W. Sampson, Esq.

Assistant Directors of Auxiliary Shipbuilding...T. A. Abell, Esq., T. W. Davis, Esq., R. M. Gillics, Esq., Peter Stobble, Esq., Dr. H. A. Trendgold and *Acting*-Col. E. W. R. Finkney, D.S.O., A.S.O.

Deputy Assistant Directors of Auxiliary Shipbuilding...Major F. L. Pickersgill, R.F.A., Henry A. Butt, Esq., O. Scott, Esq.

Directors of Ship Repairs...G. S. F. Edwards, Esq. and H. M. Grayson, Esq.

Assistant Directors of Ship Repairs...H. E. Parlett, Esq. (*act.*) and A. W. Davidson, Esq.

Deputy Assistant Director of Ship Repairs...J. W. Jack, Esq. (*act.*).

Inspectors of Shipping...H. L. J. Wilson, Esq. (*act.*); *Carp. Lieut.-Com. (ret.)* George Hickey, R.N.

Carp. Lieut.-Com. (ret.) Robert G. Withell, R.N., *Carp. Lieut. (ret.)* George Reeves, R.N.

Carp. Lieut. (ret.) John M. Elstone, R.N. and *Ch. Carp.* George Sim, R.N.

Output Staff...14 Senior Inspectors and 21 Inspectors of Shipping.

Chief Inspector of Auxiliary Shipbuilding...D. Wawn, Esq.

Assistant Inspectors of Auxiliary Shipbuilding...J. Catto, J. W. Donovan, Esqrs.

23 District Superintendents with Deputies.

Technical Assistants...J. H. Bell, W. H. Denoy, W. Bradney (*temp.*), J. E. Cole (*temp.*), G. Fuller,

M. Graham (*temp.*), H. G. Hodge, E. E. Oldershaw (*temp.*), Blanchard Peskett, T. O. Rolland

(*temp.*), Henry Sanderson, C. P. Sanderson, D. S. Smith (*temp.*), Allan Stevenson, W. L. Stuart

(*temp.*), Alexander Urwin (*temp.*), F. Walker, and S. R. Wells, Esqrs.

Technical Assistant Engineers...Benjamin Allen (*temp.*), H. T. Backhouse, John Barr (*temp.*), H. P.

Claridge, Norman A. Collard (*temp.*), John Denny (*temp.*), W. Howie, John G. Johnstone, W. M.

Morison, F. C. Postle, J. R. Robb, J. Robertson, G. O. Thompson, J. W. Thompson, and F. L.

Williams, Esqrs.

Temp. Assistant Engineers...Frederick Bolton, J. T. Orr, Thomas O. O. Chant, J. Collic, A. Drow,

H. B. Farmer, F. B. Gripper, A. B. Hurse, J. Kirkwood, G. P. Mackay, J. Mitchell, J. O. Morgan.

Lieut. W. T. Nash, R.N.V.R., O. F. H. Nightingale, W. Robson, C. M. Skinner, P. Thomas, W. F.

Ware, J. B. Whyte, C. T. Wilkinson, and J. S. Young, Esqrs.

Administrative Officers...Lynden H. E. Blake, F. P. Hopkins, John R. K. MacKenzie,

J. G. M. Smith, and W. H. Sykes, Esqrs.

Administrative Assistants...T. A. Lawrenson, A. Pickersgill, C. W. Ward, Esqrs. and

Capt. W. Ross-Brown, R.G.A.

Superintendent of Shipyard Extensions...Major G. W. Brims, M.O., R.F.A.

Temp. Clerical Assistant...W. Winstanley, Esq.

Assistant Superintendent of Forgings...H. F. W. Flower, Esq.

Temp. Assistants...Capt. C. E. C. Beadle, R.G.A., Capt. T. B. Coull, Major J. W. Hamilton, P. M.

Lieut. W. T. Nash, R.N.V.R., Lieut. Thomas Y. Stout, R.N.V.R., and Capt. E. H. S. White,

Appendix

DEPARTMENT OF THE DEPUTY CONTROLLER FOR ARMAMENT PRODUCTION.

Deputy Controller...Sir Vincent L. Raven, K.B.M.
 Secretary...W. H. Peltier, Esq.
 Naval Assistant...Eng. Com. Arthur M. Lester, D.S.O., R.N.
 Civilian Assistants to D.O.A.P....T. T. Kemp, Esq. and Evelyn Nash, Esq.
 Director of Production, Guns, Mountings and Sights...J. I. G. Leveson, Esq.
 Deputy Director of Production, Guns, Mountings and Sights...J. H. Howell, Esq.
 Assistant Directors of Production, Guns, Mountings and Sights...R. T. Glascothie, Esq., and
 Major W. Kirke Smith, D.S.O.
 Deputy Assistant Directors of Production, Guns, Mountings and Sights...Chas. A. Baker, Esq. and
 G. J. S. Orton, Esq.
 Director of Production...Torpedoes & Mines...A. H. Hall, Esq.
 Deputy Director of Production...Torpedoes & Mines...Commander Carlton G. Sherman, R.N. (act.) (ret.).
 Assistant Director of Production...Torpedoes & Mines...Lt. A. D. Acland, Esq.
 Paramine Section...Lieut. Commr. W. H. McConnell, R.N.V.R.
 Technical Advisor to R.A.M....D. T. Kemp, Esq.
 Director of Production...Ammunition...G. M. Woodward, Esq.
 Deputy Director of Production...Ammunition...Major F. L. Watson, M.O.
 Assistant Director (act.) of Production...Ammunition...Lieut. H. S. H. Ellis, R.N. (ret.).
 Deputy Assistant Director of Production...Ammunition...T. S. Rayner, Esq.

AIRSHIP PRODUCTION.

Director of Airship Production...R. C. Given, Esq.
 Airship Section...Flying Capt. Edward A. D. Maudslayi, R.N.
 Wing Commr. Harold L. Woodcock, R.N.
 Commander J. Malcolm Fraser, R.N.V.R.
 Airship Engine Section...Eng. Commr. Leslie Robins, R.N.
 Eng. Lieut. Frederick B. G. Tanner, R.N.
 Eng. Lieut. Roy G. Parry, D.S.O., R.N.
 Hydrogen Section...Lieut. Commr. Sidney K. Lowcock, R.N.V.R.
 Lieut. Charles A. Hinton, R.N.V.R.
 Lieut. Alfred H. White, R.N.V.R.
 Lieut. John H. Butler, R.N.V.R.
 Lieut. Cecil Lightfoot, R.N.V.R.
 Electric and W/T Section...Lieut. Arthur Price Reed, R.N.V.R.
 Lieut. Arthur J. Osburne, R.N.V.R.
 Airship Constructor...O. L. Campbell, Esq.
 Assistant Constructors...Lt. B. W. Evans, S. A. McCarthy, L. J. Bartlett, S. Payne, H. May,
 A. F. Cole, F. Sutcliffe, Esqrs.
 Costs...A. E. Wigfield, Esq.
 Airship Production and Inspection...T. Thurlon Jones Esq.
 Flight Lieut. M. Bartlett.
 Lieut. H. H. Haworth, R.N.V.R.
 Lieut. J. D. Greenwood, R.N.V.R.
 Sub. Lieut. D. Greenwood, R.N.V.R.
 Administrative Staff Officer...Major S. Robinson.
 Civil Assistant to D.A.P....B. Page, Esq.
 Chief Draftsman...O. Wals, Esq.

District Progress Engineers...C. F. Dowding, Esq., London; W. S. Edwards, Esq., Birmingham; J. H.
 Mills, Esq., Glasgow; C. G. Howson, Esq., Manchester; J. B. Orton, Esq., Barrow; A. H. Romms,
 Esq., Sheffield; Major F. W. Yates, R.N., Grantham; and Captain H. Wilson Young, Newcastle-on-
 Tyne.

SHIPYARD LABOUR DEPARTMENT.

Director of the Shipyard Labour Department...Sir Lynden Macassey, Esq., K.B.M., R.O.
 Assistant Directors...G. T. Morrish, Esq. (General Div.).
 J. R. Bond, Esq. (Technical Div.).
 C. J. Spencer (Labour Div.).
 Vice-Admiral W. De Salis, M.V.O. (Substitution Div.).
 Major R. Williams (Priority and Transfer Div.).

Secretary...R. E. A. Millett, Esq., I.O.S. (act.).
 Asst. Secretary...S. F. James, Esq.

Intelligence Officer...C. F. Farrar.
 Establishment Officer...H. Watson, Esq.

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Substitution Table.

Eng. Capt. (ret.) Jumper W. A. Parrott.

General Division.

Superintendent of General Section... W. Wrench Lee, Esq.
Superintendent of Negotiation Section... E. B. Ratcliffe, Esq.
Liaison Section... B. Wicks, Esq.

Labour Division.

Superintendent Legal Division... H. Fox, Esq.
Legal Assistant... C. H. W. Johnson, Esq., R. F. Ringwood, Esq.

Technical Division.

Chief Technical Inspector... A. McDermott Service, Esq.
Inspector of Women's Work... Lady Gertrude Crawford.

Priority and Transfer Division.

Assistant (1st Class)... Lieutenant A. T. Stehouwer.

The following have also been appointed, or lent from other Departments for temporary service during the War:

W. Adam, J. J. Biddleston, W. Clough, W. Graham, P. Gray, H. J. Heywood, J. B. Hill, Austin Kendall, W. Knowles, Esq., Miss M. T. Macassey, W. S. Radcliffe, H. A. Sharpe, Esqs., Miss K. Toogood, C. H. Yeatman, Esq.

Local Areas.

District Directors.

A. L. Ayre (Glasgow).
J. P. Baker (Barrow).
J. H. Brewerton (Southampton).
A. W. Chantler (Belfast).
Lt.-Col. W. Cooper (Liverpool).
Lt.-Col. A. Gable (London).
Eng. Rear-Adm. (ret.) C. W. Gregory (Leeds).
H. G. Jekill (Hull).
Eng. Capt. (ret.) J. Langmaid (Birmingham).
H. H. McClure (Newcastle).
J. Gordon (Cardiff).
Eng. Rear-Adm. (ret.) A. E. L. Westaway (Bristol).

Shipyard Technical Officers.

Eng. Rear-Adm. (ret.) J. H. Adams (London).
J. D. Mol, Barbour (Liverpool).
R. L. Botham (Cardiff).
H. Brooknall (Newcastle).
S. G. D. Cuer (Liverpool).
A. Dudgeon (Glasgow).
J. Duncan (Aberdeen).
R. C. Farquhar (Glasgow).
J. Glegg (Glasgow).
J. D. Guthrie (Bristol).
Johnston Hughes (Belfast).
J. F. James (Liverpool).
(J. Johnson (London).
J. Liddiman (Newcastle).
G. M. Mackay (Birmingham).
J. D. C. Macdonald (Glasgow).
D. M. McKay (Glasgow).
R. J. Mills (Newcastle).
F. Moorsom (Cardiff).
T. R. Seath (Glasgow).

F. W. Shady (Stockton).
C. B. Thomas (Leith).
H. Webster (Glasgow).
G. P. Wells (Hull).
J. Wilson (Bristol).

Engineer Technical Officers.

W. T. Andrews (London).
J. Boulton (Liverpool).
R. Housher (London).
J. H. Chambers (Belfast).
A. Coudrier (Hull).
C. E. Dudgeon (Hull).
E. Edwards (Birmingham).
J. W. Elliott (Manchester).
L. T. G. Evans (London).
H. Gray (Leeds).
J. B. Hamilton (Barrow).
(J. A. Hunt (Leeds).
S. B. B. Hobbs (Hull).
G. B. Hensell (Leeds).
G. S. Horne (Manchester).
G. A. Houghton (Glasgow).
G. H. Johnston (Glasgow).
A. Macdonald (Glasgow).
G. N. McVicar (Glasgow).
W. Murdoch (Birmingham).
(J. B. Nicholson (Cardiff).
J. P. Phillips (Newcastle).
J. H. Reid (Glasgow).
(J. B. Richards (Birmingham).
A. Robertson (Glasgow).
H. M. Sayers (London).
S. J. Sewell (Leeds).
Eng. Rear-Adm. (ret.) R. J. Trench (Southampton).
G. Turner (Bristol).
W. H. Warwick (Leeds).

T. Wards (Liverpool).
T. Yoxton (Newcastle).

Labour Regulation Officers.

P. Black (London).
H. Blair (Belfast).
J. Cox (Birmingham).
W. G. Cruikshank (Hull).
J. Cunningham (Belfast).
J. Evans (Liverpool).
W. H. Fisher (Liverpool).
W. M. Gibson (London).
T. Githens (Liverpool).
H. Hindon (Cardiff).
The Earl of Harwich (London).
T. D. Hooper (London).
F. A. Hird (Birmingham).
M. Ramsden (Newcastle).
R. B. Holt (Newcastle).
W. J. Jackson (Glasgow).
H. W. Johnson (Cardiff).
A. W. R. Kewley (Newcastle).
A. G. Lawrence (London).
J. M. Little (Glasgow).
A. Magnay (Newcastle).
W. Marsh (Southampton).
W. Nelson (Southampton).
R. W. Owen (Liverpool).
(J. L. Pearson (Newcastle).
W. Ramsden (Liverpool).
J. D. Rees (Cardiff).
S. Shaw (Leeds).
G. G. Steel (Newcastle).
R. Towner (Glasgow).
R. J. Waters (Newcastle).
W. J. White (Newcastle).
W. P. Williams (Bristol).
J. U. Wood (Glasgow).

Superintendents of Shipyard Labour.

Lieut.-Colonel W. Cooper (Mersey).
Lieut.-Colonel A. Gable.
Eng. Capt. (ret.) J. Langmaid (Birmingham).
A. L. Ayre (Glasgow).
J. P. Baker (Barrow).
J. H. Brewerton (Southampton).
H. G. Jekill (Hull).
H. W. Johnson (Cardiff).

Superintendents of Shipyard Labour—contd.

J. M. Little (Glasgow).
H. H. McClure (N.B. Coast).

Deputy Chief Labour Organising Officers.
H. Hindon (N.B. Coast).
W. Nelson (Southampton).

Transfer Officer

H. J. Walters (N.B. Coast).

Appendix

MATERIALS AND PRIORITY DEPARTMENT.

Director of Materials and Priority...Lieut.-Col. R. S. Hoare.
Personal Assistant to Director...Lieut. T. G. Robertson, R.N.V.R.
Assistant Directors...Eng. Capt. John A. Richards (act.),
 J. Rogers, Esq. (acting Chief Constructor),
 M. Keaney, Esq.,
 F. Smith, Esq.,
 Lieut.-Com. A. M. MacRobert, R.N.V.R.
Deputy Assistant Directors...Eng. Com. Henry G. Anstey (act.) (emloy.),
 Capt. J. H. Skelton,
 Capt. James Chishwell,
 Adrian Jamley, Esq.
Administrative and Technical Assistants...Lieut. L. Nicoll, Sub. Lieut. W. E. Sugden R.N.V.R.,
 Sec. Lieut. A. Milner, Sec. Lieut. G. H. M. Thynneson, Sec. Lieut. F. D. Saunders, R.N.,
 Sec. Lieut. A. G. Mayor, R.N., J. P. Powell, R. Jumper, D. Channon, R. C. Hawthorn,
 R. Butler, H. J. Atkwright, C. McQuon, R. P. Padbury, Hawkins Turner, L. G. Brodie, Esqrs.
Statistical Assistants...L. L. Tiddell, Esq.,
 Assistant Paymaster...G. H. (Tremson),
 Esquire of Accounts...G. W. Brown (act.).
 9 Temp., Clerks, 66 Temp. Women Clerks and Typists.

STATISTICS DEPARTMENT.

Director of Statistics...Lieut.-Col. J. G. Beharrell, D.S.O.
Deputy Director...Lieut. H. Macrae.
Heads of Sections...Lieut. J. G. M. Butterworth,
 2nd Lieut. J. Hambley,
 J. N. Hurlman, Esq.,
 A. E. Kirkus, Esq.,
 W. D. Duffield, Esq.,
 C. Collins, Esq.,
 Asst. Paym. R.N.R....William H. Anstee.

FINANCE DIVISION

Assistant Accountant-General...A. Chumpton, Esq. (act.).
Superintending Clerk...A. H. M. Fox, Esq. (act.).
Deputy Accounts Officers in charge of Branches...W. J. Hearn, Esq. (act.); R. G. Pollock, Esq. (act.).
Deputy Accounts Officers...H. H. Bain, Esq. (act.); G. H. Court, Esq. (act.),
 W. J. H. Greenland, Esq. (act.).
Assistant Accounts Officers...R. H. Westlake, Esq.; H. E. Donny, Esq. (act.) (lent from
 Inland Revenue); E. H. Johnson, Esq. (lent from Inland Revenue).
Assistant Expense Accounts Officer (lent by Inspector of Dockyard Expense Accounts)...F. Hall, Esq.
Assistant Auditors (lent from National Insurance Audit Department)...A. J. Canura, A. E. Codd,
 H. Boulds, L. H. Gibson, H. G. Kench, A. Page, Esqrs.
 4 Supervising Assistant Clerks, 1 Assistant Clerk, 1 Tired Accountant Clerk, 10 Temporary Clerical
 Assistants, 7 Temporary Assistant Accountants, 24 Temporary Men Clerks, 2 Higher Grade Women
 Clerks, 70 Temporary Women Clerks and Typists, and 15 Improvers and Boy Clerks.
 (With the exception of the Asst. Expense Accounts Officer, the Staff of this Division was
 also shown under the Dept. of the Accountant-General.)

COSTINGS INVESTIGATION DIVISION.

Advisor upon Costs of Production } A. F. Whinney, Esq., F.C.A. (act.).
Assistant Account General }
Deputy...F. W. Papworth, Esq., A.S.A.A. (Acting Superintending Clerk).
Heads of Sections...C. D. Britton, Esq., A.C.A.,
 W. Ellis Hill, Esq., A.C.A.,
 F. N. Kidson, Esq., F.C.A.,
 C. H. Oldfield, Esq., A.C.A.,
 H. F. Palmer, Esq., A.C.A.,
 C. J. Sturt, Esq., A.S.A.A. (Acting Assistant Accounts Officer).
Assistant Auditors (lent from National Insurance Audit Dept.)...J. A. Clarkson, A.S.A.A.; W. L. Karamnell,
 A.S.A.A.; S. Whincup, A.S.A.A., Esqrs.
Superintending Accountants...R. A. Blackford, A.C.A.; D. M. Butler, A.S.A.A.; E. H. Nickson, A.C.A.;
 W. J. Phillips, A.S.A.A.; B. G. Pocock, A.S.A.A.; M. Price, F.C.A.; P. W. Rumble,
 A.A.A.; C. W. Watson, F.C.A.; H. G. Wilson, F.C.A., Esqrs.

Accountants...M. M. Baker, A.C.A.; A. B. Bayley, A.C.A.; N. Bell, C.A.; R. L. Biggs, A.C.A.; W. H. Cooper, A.S.A.A.; J. Dickson, C.A.; H. V. Edwards, A.C.A.; F. Ellington, A.C.A.; A. Fielding, A.C.A.; H. Garman, A.C.A.; H. G. Gainsbield, C.A.; C. T. Grimes, A.C.A.; A. Hosking, A.S.A.A.; H. C. Howard, A.S.A.A.; J. A. Lewcock, A.S.A.A.; H. Laker, A.S.A.A.; W. E. Mann, A.S.A.A.; W. J. Morion, A.S.A.A.; G. T. Needham, A.C.A.; G. V. Oldfield, A.C.A.; J. Potter, A.S.A.A.; B. Smith, A.C.A.; J. S. Stuart, A.S.A.A.; M. M. Taylor, A.C.A.; R. S. Townson, A.C.A.; H. Tweedale, A.C.A.; P. H. Walker, A.S.A.A.; C. C. Wilson, A.S.A.A.; J. G. Wolfe, A.C.A.; T. C. Whitaker, A.S.A.A. *Flags*.

61 Temporary Assistant Accountants, 1 Temporary Man Clerk, 20 Temporary Women Clerks, 5 Boy Clerks, 91 Third Grade Clerks and Records.

DEPARTMENT OF THE DIRECTOR OF NAVAL ORDNANCE.

Director of Naval Ordnance...Captain Frederick C. Droyer, C.B.
Assistant-Director of Naval Ordnance...Captain Joseph C. W. Henley.
Assistants to Director of Naval Ordnance.

<p><i>Commander</i> Charles A. Scott. Edward O. Cochran. Isiah W. Gibson, M.V.O. Bernard W. M. Fairbairn. Archibald Gilbert (act.). Edward G. de S. Jukes-Hughes. (G) Stanley T. H. Wilton.</p>	<p><i>Commander (G)</i> Gerald F. Loughurst, R.N.S.O. (temp.). <i>Comdr.</i> R.N.V.R. John G. Henderson (act.). <i>Lieut.</i> Walter R. Gilbert. Willio D. Kilroy, R.N.V.R. (temp.). <i>Sub-Lieut.</i> W. H. J. Kirtidge, R.N.V.R. (temp.). <i>Chief Gunner</i> Herbert D. John. <i>Commissioned Armourer</i> Ernest Addy.</p>
---	--

Lieutenant...Frederick J. Fynda.
 Malcolm A. McKenzie.

Engineer Inspectors.

<p><i>Eng. Captain</i> Thomas Thomas (temp.). Henry Wall.</p> <p><i>Eng. Commander</i> William Hart.</p>	<p><i>Eng. Commander</i> Walter G. Heppel. Frederick C. H. Panton (temp.). Frederick Robertson (act.).</p> <p><i>Eng. Lieut.-Com.</i> Stanley W. Cooke.</p>
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Chief Inspector of Naval Ordnance...Commander (act.) John A. Duncan, C.B.
Assistants to Chief Inspector of Naval Ordnance...Commander Henry G. R. Boyen (ret.).
 Commander Ralph G. Dinwiddie.
 Commander Leslie J. L. Hammond (ret.).
 Commander (act.) John A. T. Jany.
 Captain Freeman C. N. Bishop, R.N.A.
 A. H. Dodd, Esq.

Examiner of Gun-Mounting Accounts...A. H. Duffield, Esq. (act.).
Examiner of Gun-Mounting Work...W. R. D. Holmer, Esq. (act.) (temp.).
 The following gentleman has been sent for special service during the War...J. Stacey, Esq.
Naval Officers employed on Inspection and Experimental Ordnance Duties.

Under Chief Inspector of Naval Ordnance:—

Inspector of Steel...Commander Harold G. Jackson (ret.).
Deputy Inspector of Steel...Colonel J. R. J. Jocelyn, R.A. (ret.).
Civilian Inspector of Steel...Lieut. D. R. Horwood.
Acting Inspector of Steel...Commander (act.) Lowellyn E. H. Lowellyn (ret.).

Assistant Inspectors of Steel.

<p><i>Admiral (ret.)</i> Sir Edmund S. Poe, O.V.O., K.C.B. <i>Major-General</i> R. Waco, C.B., M.A. (temp.). <i>Captain</i> H. R. Evans, R.M. (ret.). William H. M. Danell, R.N. (ret.). Claude W. M. Flinders-Smith, R.N. (ret.). William H. F. Taylor, R.M. (ret.). <i>Commander</i> Henry Thompson (ret.). Charles K. McCallum (ret.). John E. Bray (ret.). T. S. Gorch (Emerg.). A. H. Trouwano (ret.). Reginald C. Brenton (Emerg.). <i>Commander</i> R.N.R. W. P. Osburne, C.B., M.D. (ret.). <i>Lieut.-Com.</i> Arthur W. Tomlinson. Frank H. Willis. Hugh J. Orr (ret.). John G. M. Molinard (ret.). Robert F. Veasey (ret.). Alister W. McDonald (ret.). Ralph B. Bodilly (ret.). William H. Oatwell (ret.). Henry L. Chenton (Emerg.) (act.). Frederick J. Davis, M.D., R.N.R. (ret.). W. B. Couston (ret.). W. G. H. Croo (ret.).</p>	<p><i>Lieut.-Com.</i> John H. C. Ordby (ret.). Robert A. O. Montagu (ret.). <i>Lieut.</i> Robert J. Swast (ret.). <i>Lieut.</i> R.N.R. Beauchamp H. Vennor (ret.). <i>Lieut.</i> R.N.V.R. Tom M. Chantler. <i>Colonel (temp. Brig.-Gen.)</i> Cooper Penrose, R.E. <i>Colonel</i> C. L. Robinson (ret.) (temp.). W. H. Williams, C.M.G. H. D. Olivier. D. A. Mills, R.N. (ret.). A. L. Mohr, R.E. (ret.). M. H. Purcell, R.N. (ret.). W. Hutchinson, C.M.G., M.B. (ret.). <i>Br. Col.</i> S. V. Thornton, R.A. (temp.). <i>Br. Col.</i> H. O. Nelson, R.A. (temp.). <i>Lieut.-Col.</i> G. Mackinlay, R.A. (ret.) (temp.). F. H. Elliott, O.S.I., R.A. (ret.) (temp.). Allan Wadmore (temp.). A. Tracey (temp.). <i>Major & Br. Lt. Col.</i> Frederick L. Diblee, R.M.A. <i>Major</i> Charles A. Bishop, R.M.A. R. E. Fitzgerald-Lombard (ret.). <i>Captain</i> G. B. Macpherson Grant (temp.). <i>Captain</i> Alfred D. B. Godfrey, R.M.A. <i>Captain</i> A. J. Beckwith, R.E.</p>
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Gunner (ret.) Richard W. Lawrence.

Appendix

The following gentlemen have also been appointed for temporary service during the War :

14. B. Bowell, J. W. Chumbley, R. H. Deane, T. I. Dwyer, B. B. Fox, H. B. Hall, C. J. Hill, W. R. C. Jackson, Dr. C. H. Johnson, L. T. Jarvis, A. Johnson, J. L. Killo, R. Lake, A. B. Lee, Louis Mackenzie, G. Marshall, C. H. Moore, G. B. Moss, A. B. Napier, H. Percival, D. Platon Prichard, G. Watson Ramsay, C. Romm, T. W. Sheppard, J. W. Slater, L. L. French Watson, G. Tunnah, A. Warry, G. H. Wells and H. White, Esqrs.

Lent from Home Office.

15. Topham, S. R. Bennett, A. G. Lowe, C. G. Sumner, E. L. Meadlin, C. F. Hunter, W. H. Mead, W. Turner, R. Bowen, A. A. Hepburn, C. H. Taylor, C. B. Pinche, F. W. Cockshott, A. Pother, William, L. D. Hooper, H. T. Kingslow, and W. G. Evans, Esqrs.

16. H. C. Newby, Esq., *Deputy Cashier (act.)*, under the Inspector of Fleet, Sheffield
(lent from the National Health Insurance Comm.).

Under War Office.

<i>Colonel</i> , Archibald G. Crookson (<i>act.</i>), (<i>ret.</i>).	<i>Major (Temporary Lieut.-Col.)</i> Nathaniel F.
<i>Major R.M.A.</i> Henry R. Stephens.	Trotman, R.M.A.

The following gentlemen have been appointed for temporary service during the War :

J. L. Capen, H. Jackson, A. McPherson, and P. R. Conway, Esqrs.

Superintending Clerk... Thomas G. Andaman, Esq.

Deputy Superintending Clerk... W. P. Daniels, Esq. (*act.*).

Assistant Superintending Clerks... A. G. Jones (*act.*), E. Morrison, S. W. Smith (*act.*) and G. Stevens (*act.*), Esqrs.

1 Second Division Clerk, Dockyard Clerks (including Ship) First Grade 1, Second Grade 2, Third Grade 3, Temporary Clerks and Boys 23, Draughtsmen 7.

Superintendent of Ordnance Stores... Captain Herbert R. Norbury, R.N.

Deputy Superintendent of Ordnance Stores... H. Fother, Esq., I.S.O. (*act.*).

Assistant Superintendents of Ordnance Stores... A. McFarlane (*act.*).

G. B. Woodward (*act.*), Esqrs.

Naval Ordnance Store Officers... W. A. Mortimer (*act.*), W. Rowe (*act.*), M. Thomas (*act.*), W. Vaughan (*act.*), and R. W. Whitburn, Esqrs.

Deputy Ordnance Store Officers... W. B. Kyle (*act.*), H. G. Hetherell (*act.*).

G. H. Murray (*act.*), and A. T. Reed, (*act.*), Esqrs.

11 Naval Ordnance Store Officers... A. H. Heavil (*act.*), W. B. Hurdson (*act.*), J. A. Kelghley (*act.*), E. W. Lambie (*act.*), G. Stanford (*act.*), R. H. Strickland (*act.*), and H. C. Tunnay, Esqrs.

Receivers of Naval Ordnance Work... W. D. Evans (*act.*) and P. J. Payne, Esqrs. (*act.*).

1 Ordnance Depot Clerk, First Grade.

8 Ordnance Depot Clerks, First Grade (act.).

6 Ordnance Depot Clerks, Second Grade (act.).

3 Ordnance Depot Clerks, Third Grade.

5 Ordnance Depot Clerks, Third Grade (act.).

1 Assistant Clerk.

23 Temporary Mixed Extra Clerks.

31 Temporary Women Clerks.

3 Boy Clerks and Boy Writers.

Acting Assistant Ordnance Store Officer... Sheffield... G. Swift, Esq.

Chief Analyst... Sheffield... John C. W. Humphrey, Esq.

The following have been appointed for special temporary service :

Dr. C. Wetmann.

Dr. Ida S. Maclean, H. Davies, E. G. Bainbridge, and H. Spence, Esqrs.

DEPARTMENT OF THE DIRECTOR OF TORPEDOES AND MINING.

Director of Torpedoes and Mining..... Rear-Admiral The Hon. Edward S. Fitzherbert.

Secretary

Assistant Director (T).
Captain Algernon H. C. Gandy.

Assistant Director (M).
Captain F. Shirley Mitchell-Smyth, O.M.C., D.S.O.

Assistant Director (T)..... Captain Vernon H. B. Haggard.

Naval Staff.

Rear Admiral...R. S. Phipps-Honby, C.A.S.	Lieutenant.....Rodolph H. F. de Salis, D.S.O.
(tempy.)	Alfred J. Parker.
Captain.....Gordon G. Fraser (ref.).	Harry Simpson.
Bryan G. Godfrey-Faussett, C.V.O.,	Fleet. } E. W. Taylor.
C.A.S. (ref.).	E.N.V.R. } Robert J. Garnthwaite, D.S.O.
Commander...Evan C. Brambury.	John R. K. Warneford.
Geoffrey C. Candy.	Eng. Capt. ....F. J. Mooto (ref.).
Thomas R. Florio.	Capt. Inspector of Mines.
Malcolm K. Grant (ref.).	Eng. Commr....Charles J. M. Wallace.
Robert W. Dalgety, D.S.O.	Edward O. Hestford.
Gerard B. Riley (ref.).	Alfred R. Kinnaird.
(T) Archibald A. Tovey-Cameron.	Vernon A. A. Ter Ven.
Robert J. Howard (act.) (ref.).	Ch. Gunner...James Wood.
Lieut.-Commr. Charles G. Alexander.	Gunner.....Leonard Repton.
Bertram Vigne.	Walter Thorpeood.
Lieutenant...Patrick P. Coleman.	Walter F. Williamson.

Civil Staff.

Deputy Superintending Clerk (act.).....P. E. Coumlin, Esq.
Inspector of Mines & Mining Genl.....W. Pearce, Esq.
1 Dockyard Clerk, First Grade (act.).
2 Dockyard Clerks, Second Grade (act.).
1 Dockyard Clerk, Third Grade.
1 Dockyard Clerk, Third Grade (act.).
2 Draughtsmen.
6 Temporary Clerks.

TORPEDO STORES DIVISION.

Superintendent of Torpedo Stores.....Frederick Ward, Esq.
Assistant Superintendent of Torpedo Stores.....T. W. Midmer, Esq.
Torpedo Store Officer.....J. W. Ballard, Esq. (act.).
Deputy Torpedo Store Officers.....G. C. Ossems (act.) and W. E. Fuller (act.) Esqrs.
Assistant Torpedo Store Officers.....W. Evans (act.) (tempy.) and F. Stokes (act.) Esqrs.
2 Torpedo Depot Clerks, First Grade (act.).
3 Torpedo Depot Clerks, Second Grade (act.).
13 Temporary Hired Extra Clerks.
11 Temporary Women Clerks.
6 Boy Clerks and Boy Writers.

AIR DEPARTMENT.

Chief of Naval Air Services (Fifth Sea Lord).....Commodore Godfrey M. Paine, C.B., M.V.O.
Asst. Chief of Air Services and Naval Asst. to Fifth Sea } Captain Arthur V. Vryyan, D.S.O.
Lord.....
Civil Assistant to C.N.A.S. ....W. A. T. Sherto, Esq. (Leat. Controller's Dept.)
Secretary to C.N.A.S. ....F. C. C. Young, Esq. (act.) (tempy.)
Staff Paym. C. A. Shove.
Assistant to C.N.A.S.
Captain Supd. for Airships.....Wing Captain H. D. Bulger.
Asst. Supd. for Engines.....Wing Captain E. M. Melkand, D.S.O.
Personal Captain.....Wing Commander (A) W. Bulger (act.).
Armament Captain.....Captain John D. Edwards, C.B.
.....Squadron Commander J. W. O. Dalglish.
.....Captain (act.) Hon. Arthur Stoford.

Commander.....H. T. A. Bomanquet.
A. D. Warrington-Morris.

Wing Commanders.

W. A. Brock (act.).	J. D. Mackworth.	L. D. M. Robertson.
J. L. Forbes.	Francis Hunkin (act.).	H. L. Woodcock.
A. M. Lunnmore.		

Squadron Commanders.

J. Bird (act.).	T. D. Mackie.	J. F. Wilson, D.S.O.
D. Hyde-Thomson.	The Master of Semphill.	

Flight Commanders.

T. A. Balchelor.	H. F. S. Leslie, D.S.O.	F. J. C. Roberts.
G. W. Cranfield.	E. W. Jervis.	
W. P. Groves (act.).	R. E. Penny.	

Engineer-Lieutenant.....F. W. Scarff (act.).

Appendix

<p>T. P. M. Alexander. H. P. Chase. M. J. C. Day. D. (III) W. H. Greer.</p>	<p><i>Flight Lieutenants.</i> K. H. F. Grolg. H. E. Jones. S. Nixon. G. G. Oummanoy. J. E. M. Pritchard.</p>	<p>R. A. Beld. G. G. Simpson, D.S.O. R. H. Horn, D.S.O. D. C. Waylen. A. W. Williams.</p>
<p><i>Observer Lieut.</i> R. F. Turner. <i>Flight Sub-Lieuts.</i> R. F. Freeman.</p>	<p>A. W. Kay. P. G. O. Paseman. H. J. Rouch.</p>	
<p>R. E. H. Allen. G. H. Brown. J. E. Call. G. E. Cole. J. Collet. J. V. Collins.</p>	<p><i>Variant Officers (2nd grade).</i> M. G. Cooper. W. T. Omlis. A. Duckin. A. H. Ellis. J. Hobbs. F. J. Hooper.</p>	<p>G. T. Mitchell. G. W. Pickock. A. H. Redstone. W. Renshaw. A. Shier.</p>
<p>A. W. Turner. G. Holme.</p>	<p><i>Commander, R.N.F.R.</i> G. H. Menes.</p>	<p>J. R. Steele.</p>
<p></p>	<p><i>Lieut.-Commander, R.N.F.R.</i> J. Mills.</p>	
<p>G. R. Abbott. M. H. P. Allen. Q. R. Andrews. J. Culler. J. K. Curwen. F. R. B. Davis (act.). S. T. Dockray. S. Flower. J. M. Fraser. G. W. Gaubie.</p>	<p><i>Lieut.-Commanders, R.N.F.R.</i> B. T. Hamilton. J. Mills. R. W. Hogarth. E. Hogg. G. Kent. H. R. Lowcock. G. McAlpine. T. A. Monckton. O. J. Murfit. R. F. Norbury.</p>	<p>G. C. Nelson. W. E. Plaster. G. M. T. Rees. J. D. K. Rastler. J. C. Savago (act.). C. F. Steele. F. C. Williams. H. B. Whipple.</p>
<p>T. C. Abbott. G. J. R. Alford. F. A. Baldwin. H. Balfour. E. C. Blake. J. P. Bonica. R. J. P. Briggs. W. Hinchshaw. J. H. Inglis. E. R. W. Innt. D. Cameron-Swan. J. D. Carmichael. W. H. Clegg. J. W. Cole. T. A. Cotton. J. R. Craig. J. C. T. Crawford. G. Chawley. H. Curtis. G. R. D'Arcy. A. J. Davis. L. M. Davou. H. Dudd. A. J. Dronsfield. J. P. Eskin. W. C. Evans. H. Evans. N. Fawkes. P. L. R. Fraser. N. H. Fuller. J. H. Gibb. R. D. N. Gilmore. D. Good. G. M. Gordon. T. H. Grant. W. O. Grant. J. E. A. Greston. J. D. Greenwood. J. W. Griggs. Hon. J. G. W. Guest. R. D. Hallam.</p>	<p><i>Lieutenants, R.N.F.R.</i> J. R. Hallam. E. H. Haworth. G. Hazellton. J. H. Hedley. S. R. Hemmingsway. H. H. Hill. J. B. Homer. T. G. B. Hooke. H. H. Horne. R. G. Homroy. H. Howard. D. G. M. Hume. A. J. Hunt. R. H. Kennedy-Hampton. A. J. B. Kennott. W. H. M. Knox. W. A. Lawrence. G. Layzell Apple. G. W. Lester. M. V. J. Lysaux. G. Lightfoot. A. H. Low. W. Makover. D. Mansbridge. M. Marsden. W. L. Marsh. O. H. Mason. J. T. Matthews. R. T. Melhold. T. B. Meyer. M. J. H. Molyneux. J. W. Moore. G. H. More. N. P. Merila. W. A. Morrison. S. R. Mulard. N. D. Newall. A. D. Newbury. T. L. Oliver. R. B. Ollershaw. J. H. Orsby.</p>	<p>A. J. Osborn. G. L. T. Owen. T. A. Parker. D. R. Parry-Jones. O. H. Powell. L. M. M. Pyke. J. Reed. A. P. Reed. A. J. Reed. P. H. Richy. B. V. Roche. K. Seccatan. W. Sherson. G. C. Shepherd. F. C. H. C. Sinclair. N. Shadden. C. A. Slater. A. F. H. Smallpiece. H. Spink. F. H. Spragg. A. M. Steele. G. Suchling. J. A. C. Sumner. P. J. H. Sumner. R. B. C. Talboys. M. L. Taylor. A. K. Toulmin-Smith. G. L. Tyner. R. C. Walker. H. N. Warburton. W. G. J. Wardle. H. A. Watts. P. Westacott. A. H. White. C. Wilder. N. H. Wood. T. M. Wilson. H. C. Wright.</p>

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Staff Paymaster, R.N.R...... S. B. F. Carter.

Sub-Lieutenants, R.N.R.

F. A. Barton.
A. Berry.
B. B. Cain.
H. Churchman.
R. F. Cook.
A. B. Davies.
B. M. J. Davis.

H. A. Evans.
T. P. Francis.
S. Gillman.
J. Greenwood.
J. H. Gills.
G. Harris.
H. W. Horn.

E. A. Houghton.
E. C. Hubbard.
J. Logle.
D. F. Luching.
W. B. Sinclair.
C. R. Sklancr.

Asst. Payms. R.N.R.

G. F. Green.

N. C. I. Pugh.

Asst. Paym. R.N.V.R...... T. F. Legard.

Wt. T'leg. R.N.R...... S. S. McLeod.

2nd Lieut...... A. Berry.

Orill Staff.

Deputy Superintending Clerks... E. W. Griffin and
W. A. Medrow (act.) Esqrs
Chief Examiner... J. H. Jones, Esq. (act.)
(Lent from Inland Revenue).
Examiner... C. R. Pledger, Esq. (act.)
(Lent from Inland Revenue).
Inspector of Aircraft Armament... R. D. Dow, Esq.
2 Minor Staff Clerks (act.).
4 Second Division Clerks (2 serving with
Army).

3 Assistant Clerks (1 serving with Army).
1 Extra Clerk, 1st Class.
1 Tempy. Accountant Clerk, 1st Class.
2 Asst. Inspectors of Aircraft Armament.
81 Temporary Clerks.
5 Temporary Women Clerks, Higher Grade.
73 Temporary Women Clerks.
7 Boy Clerks.
4 Draughtsmen.

(d) ADMIRALTY, END OF NOVEMBER, 1918.

First Sea Lord and Chief of the Naval Staff.....Admiral Sir Rosslyn B. Wemyss, K.C.V., C.M.G., M.V.O.

THE NAVAL STAFF.

Deputy Chief of the Naval Staff Vice-Admiral (act.) Sydney R. Fremantle, C.B., M.V.O.

Assistant Chief of the Naval StaffVice-Admiral Sir Alexander L. Duff, K.C.B.

Deputy Chief of the Naval StaffRear-Admiral Herbert G. W. Hope, C.B.

OPERATIONS DIVISION.

Directors of the Operations Division.....Captain Charles F. R. Coode, D.S.O.

Captain Alfred D. P. R. Pound.

Deputy Directors of the Operations DivisionCaptain Bernard St. G. Collard, D.S.O.

Captain Arthur de K. L. May.

Assistant Directors of the Operations DivisionCaptain Henry K. P. Aylmer.

Lieut.-Col. Walter F. C. Jones, D.S.O., D.S.L.I.

Naval and Marine Staff.

Captain.....R. P. (Stanton (act.).
Chiv. Ad. Marston (act.).
George T. C. P. Swinney, D.S.O.
Houston G. J. (Grant (act.).

Commander .. George J. B. Edward-Collins.
Hugh T. Garland.
Leonard Holmston (act.).
Henry F. H. Wakefield.
Thomas F. P. Calver.

Commr. R.N.R. The Duke of Sutherland.
(J. Hamilton (act.).

Lieut.-Comm.....Melville A. Hawes.

Major R.A.M. Harold I. Dour.

Lieut. R.N.V.R. Sidney T. Mouls.

Captain R.A.F. Cyril S. Giddard.
Thomas C. Spunwar.
Charles J. Turner.

Civil Staff.

Staff Clerk in Charge..... F. R. Hitley, Esq. (act.).

(Acting for Gunnery and Torpedo Division.)

1 Minor Staff Clerk (act.).

1 Second Division Clerk.

3 Assistant Clerks.

1 Confidential Shorthand Writer.

1 Accountant Clerk.

10 Temporary Clerks.

4 Women Clerks.

Cartographer...A. F. Gibson, Esq.

PLANS DIVISION.

Director of Plans.....Captain Cyril T. M. Fuller, C.M.G., D.S.O.

Assistant Directors of Plans{ Captain Ragnar M. Colvin.

{ Captain Kenneth G. B. Dewar.

{ Captain Alfred H. B. Carpenter v.o.

Naval and Marine Staff.

CommanderAlfred H. Taylor.

Henry T. Dooling, D.S.O.

Colonel R.A.F. Cyril J. L'Estrange-Malone.

LieutenantCharles W. L. Meynell.

Lieut. R.N.V.R. Hugh Micklem.

Lieut.-Col.Lewis S. T. Halliday, v.o. C.B., R.N.

Major.....Godfrey P. Ord, R.N.R.

Paym. Lieut.-Commr. Ernest D. G. Colles (act.).

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Civil Staff.

Staff Clerk...A. Duckhouse, Esq. (act.).
4 Temporary Clerks. 4 Women Clerks.

NAVAL INTELLIGENCE DIVISION.

Director of Naval Intelligence...Rear-Admiral Sir W. Reginald Hall, K.C.M.G., C.M.
Deputy Director of Naval Intelligence...Captain Raymond A. Nugent, C.M.G.
Assistant Directors of Naval Intelligence...Captain William M. James.
Captain Raymond Fitzmaurice, D.S.O.
Captain Vivian R. Brandon (act.).
Lieut.-Col. Walter Sinclair, R.M.L.I.
Lieut.-Col. Arthur Peel, R.M.L.I.
Commandant Intelligence SchoolMaj.-Gen. J. F. Daniell, C.M.O., R.M.L.I.
Civil AssistantHugh Broadbent, Esq.

Naval and Marine Staff.

Commander Morris W. Cochane, D.S.O. (ret.). Geoffrey B. Spicer- Simson, D.S.O. Walter C. Lucas, Malcolm H. H. Mac- Donald, D.S.O. Arthur W. Wood (act.) (ret.). Lionel R. H. Royle. Bernard Huxton, D.S.O. Wilfrid A. Thompson Geoffrey S. F. Nash. George H. Lang, D.S.O. Walter T. Bago (act.).	MajorCool E. S. Wright, R.M.L.I. Charles B. Mullins, R.M.L.I. Charles E. W. Hill, R.M.L.I. R. A. Moulton, D.S.O., R.M.A., (ret.). J. O. Farmer, R.M.L.I. J. W. Signe, R.M.L.I. Lieut.Edward S. Williams, Andrew H. M. Tag- gard, F. B. Bellfield, Kenneth F. Collier. Lieut. R.N.Z. Wilfred A. Atwell (tempy.). Lieut. } Arthur B. Watts. R.N.V.R. } P. Romer. A. F. Stevenson. A. D. Knox. M. Harrison. E. C. J. Green. E. Bullough. G. L. N. Hope. J. A. Willoughby. Lionel B. Wix. Dudley M. N. Fitz- gerald. Frederick R. Le B. Smith. John P. Curwen. Donys Bond. Benjamin S. J. Phillips. Neville Forbes. Burton S. R. Cope. J. D. Bentley. H. C. Quiggin. Desmond Macaulay. Harold G. B. Dillon. Walter H. Brulford. Francis G. C. Leeson. David Wilson. (Lieut. H. Wright). Albert W. Waterhouse. Henry R. Bowley. John Cooper.	Lieut. } H. H. Anderson. R.N.V.R. } E. P. Kelwin. G. L. Lawrence. O. T. H. Blahbeth. J. S. Blake-Read. Alexander H. Smith. John F. Tora. Douglas G. Pugh. Henry W. C. Thirar. Maurice H. L. Met- calfe. John E. Bevan (act.). J. O. Forster (act.). G. W. Carew-Hunt. G. H. Dummett. G. L. Bickensbeth. Capt. R.M. } Frank E. Bowen. Capt. R.M. } (Res.) S. O. K. Christie. Capt. R.M. } C. W. Hardisty. (unattached) } C. P. Oulons. R. Orr-Paterson. J. D. Steel. Lieut. R.M. } Gordon H. Robinson, Instr. } Chy V. Rayment. Commr. } B.A. Paym. } Charles J. E. Rotter Capt. } C.H. (act.). Paym. } Ernest W. O. Thring. Commr. } William H. Eves. Paym. } John N. Fletcher. Lt.-Com. } Lloyd Hirst (act.). Tempy. } Oscar Pukes, M.D. Surge-Lieut. } Hubert S. Burgess Paym. } (act.). Lieut. } R.N.Z. Sub-Lieut. } Sam B. Williamson. R.N.V.R. } Montague L. W. Paym. } Filca. Sub-Lieut. } Hon. Robert F. P. C. R.N.Z. } Vernon. Paym. } F. J. L. Robertson. Sub-Lieut. } P. R. Swanton. R.N.V.R. } G. P. Mackeson. Schnr. } Frederick Bush. Lieut. (act.) } Harry P. Green- Midshipman } wood (tempy.).
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Additional Officers borne temporarily for the Naval Staff, were shown in the Navy List under 'President.'

Civil Staff.

Staff Clerks— A. C. T. Turner, Esq. (act.). 2 Second Division Clerks. 1 Confidential Shorthand Writer.	Cartographer— O. Brickenden, Esq., M.R.E. 2 Second Division Clerks. 1 Confidential Shorthand Writer.	2 Assist. Clerks, 7 Temp. Clerks. 1 Supervising Assl. Clerk (act.). 7 Boy Clerks, 51 Women Clerks. 22 Draughtsmen. 2 Photographers.
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† The following have been appointed or lent for temporary service during the War :—

The Hon. Mrs. Acland (unpaid), W. H. Anstie, M.A. (lent from Dartmouth College), Esq., *5th* P. W. Baker-William, M. L.B., *Lieut.* J. M. Ball, Miss Barlow (unpaid), Rev. V. M. Barnard, *Lieut.* R. (i. Barnes, J. W. Baskenah, Esq., Miss Beaver (unpaid), *Lieut.* E. J. Bolton, H. B. Boulton, F. H. Boulton (unpaid), Esq., *2nd Lieut.* R. N. Bradshaw (unpaid), T. Bruce (unpaid), Esq., *Capt.* J. W. Burton, *2nd Lieut.* W. M. Calder, J. W. Campbell (unpaid), Esq., Miss Calk (unpaid), A. Calk, C. S. Chasbon (unpaid), W. J. Childs (unpaid), C. R. Coates, C.M.G., Esq., E. C. Collingwood (unpaid), Esq., *Lieut.* W. B. Collinson, *Capt.* P. J. H. Collins, O. M. Linton (unpaid), Esq., *2nd Lieut.* A. C. Dickie, H. N. Dickson, C.M.G., M.A., D.Sc., Esq., Miss R. Dodd, Miss Doughton (unpaid), J. M. Dyer (unpaid), Esq., Rev. C. Edmundson (unpaid), C. B. R. Ellis (lent from Local Govt. Board), M. Fennelwood (unpaid), E. Fetherstein, O. P. Fisher (unpaid), G. H. Fitzmaurice, C.B., C.M.G., H. R. Forth, Esq., *Lieut.* W. J. Fraser, *Lieut.* D. H. Fuller, Mrs. A. M. Guard, J. L. Gerrard (unpaid), L. Gilie (unpaid), Esq., Mrs. Goldschmidt (unpaid), Mrs. Good (unpaid), J. W. Goodwin, Esq., Dr. E. O. Gough, Miss Graham, A. G. Hamblin, Esq., Miss (Mrs.) Harman (unpaid), *Lieut.* E. M. Harman, *Capt.* T. H. Hardy, *Capt.* S. G. Harvey, Professor J. B. Henderson (unpaid), *Lieut.* R. J. Henson (Loulton Rd.), Miss K. Horsfall, Mrs. Howarth (unpaid), G. J. Howarth (unpaid), J. B. Hutton, Esq., *Lieut.* J. H. Inskip, R.I.F., H. H. Irving, Esq., Miss M. T. Jenkin, F. W. Kell (unpaid), Esq., *Capt.* J. Kennaway, W. S. Kennedy, J. W. Lawrence, J. Lowin, E. Lohel (unpaid), Esq., *Capt.* D. H. Loch, Major R. J. Luard, C.M.G., D.Sc., (Indian Army, ret.), J. L. Morison Macdonald, (unpaid) Esq., Professor A. A. Macdonell (unpaid), H. Macfarlane (unpaid), J. Macfarlane (unpaid), T. W. Marlon (unpaid), Esq., *Lieut.* K. C. Marlowe, *Capt.* E. H. Molyneux, D. Montgomerie, Esq., Rev. W. Montgomery, M.A., Mrs. Moon (unpaid), Mrs. Stuart Moore (unpaid), L. G. Collinson Morley (unpaid), D. Morham (unpaid), R. Novell, R. D. Norton, Esq., Miss M. V. Nugent, Miss D. G. N. O'Connor, Lady Alexandra Paget (unpaid), H. J. Panton (unpaid), *Lieut.* V. N. Peel, G. W. Prothero, Esq., *Lieut.* P. W. Rix, Miss M. L. Robertson, H. Russell, Esq., Miss Butler (unpaid), Dr. P. B. Sandbach, Miss C. A. Stummus, Lord Stummus, Professor W. B. Stevenson (unpaid), C. G. Stone (unpaid), Esq., *Lieut.* F. N. Stringfield, P. Stander (unpaid), Esq., *Capt.* W. H. Tapp, Miss Taylor (unpaid), R. C. Trench, Esq., R. Vaughan-Williams, M.C. (unpaid), Esq., *Lieut.* A. Ventura, B. C. Wallis (unpaid), Esq., Rev. A. M. Ward, Miss Wally (unpaid) Miss R. M. Wicksford.

TRADE DIVISION.

Director of Trade Division.....Captain Alan G. Ho(ham).

Assistant Director of Trade Division ...Captain Charles T. Hardy.

Secretary to D.T.D.Paym. Commr. (act.) John Siddalls

CaptainsW. H. D. Marresson (ret.),
Philip Walter (ret.),
Frederick K. O. Githona (ret.),
Lawrence L. Dandini, C.M.G.,
Hubert (i. Alston, C.B.,
Thomas Fisher (act.)

Commander Sir Charles L. (and, Bt., K.C.V.O.,
C.B., C.M.G., C.B.E. (ret.),
Oscar V. de Salgo (ret.),
A. H. Tuleton, M.V.O. (emer.),
Francis B. Wrottesley,
Francis H. L. Lowin,
Guy R. Livingston (ret.),
Hugh W. James Livingston (ret.).

Commander } Walker H. Wilkes, R.N. (ret.).
R.N.R.

Commander } William Ginnman (act.).
R.N.V.R.

Lieut.-Com. { W. E. Arnold-Foster (temporary)
R.N.V.R. { detached,
L. McCormick-Goodhart (act.).

Lieut. } P. H. McCormick-Goodhart
R.N.V.R. } Eugene A. Tang,
John McK. Robertson,
Arthur Bright-Smith,
Albert P. Mecklenburg, M.C. (act.)
Eng. Capt. ...Henry C. Reah (act.).
Lieut.-Col. ...Thomas H. Hawkins, C.M.G., R.M.L.I.
Paym. Capt. { Ibrahim Howick (act.),
Cunningham Prior,
William H. Scotland,
Geoffrey T. Smyth,
George W. Watson.

Paym. }
Lieut. } W. A. J. Boxford (act.).
Commr. }
R.N.R.

Paym. }
Lieut. } Joseph H. Wilson,
R.N.R. }
Sub-Lieut. ...Volstead St. J. Van der Byl,
Paym. } Stanley G. Wood,
Sub-Lt. } W. J. Gladd,
R.N.R. } Thomas Bawden-Provia,
Paym. }
Sub-Lt. } R. Johnstone Douglas,
R.N.V.R. } Hugh S. Kingsford.

Civil Staff.

Staff Clerk.....C. Brown, Esq. (act.)

2 Second Division Clerks.
4 Clerical Assistants.
18 Temporary Clerks.

3 Boy Clerks.
4 Higher Grade Women Clerks.
33 Women Clerks.

The following have been appointed for temporary service during the War :

1. B. Moss Rhindell, Esq., C.B.E., Sir Frederick Bolton (unpaid), W. H. Hargreaves, Esq. (unpaid),
L.D. (unpaid), G. D. Hardinge-Tyler, Esq., J. Heron Lepper, Esq.

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SIGNAL DIVISION.

Acting Director of Signal Division.....Captain...Richard L. Nicholson, D.S.O. (act.)

Naval Staff.

CaptainJohn A. Snee (act.) (Head of 1717 Board).
Commander ...Gerald B. Villiers.
Lieut.-Com. ...Edward L. B. Oliphant.
Lieut.-Com. } W. Cleveland-Stevens (act.).
R.N.V.R. }
Lieut.Frederick W. Boswell.
Lieut. R.N.V.R....Frederick W. Atterbury.
Lieut.Lionel W. Linnalington.
Major R.M.A....Stephen C. Waco.
Major R.M....Edward (Hillside, D.S.O.
Capt. R.M. ...Arthur J. Meilor.
Paym. Com....John B. A. Brown (act.).
Paym. Lt.-Com....Bernard A. B. Bromley.

Paym. Lt.-Com....Alexander C. Hume (act.).
Edward W. H. Travis (act.).
George R. Russell (act.).
Paym. Lt.-R.N.V.R... John W. Selie, D.S.O.
Gerald T. B. Cockrell.
Sub-Lt R.N.V.R....Laurence C. Robinson.
George H. Lindsay.
Russell Williams.
John F. H. Grant.
Paym. Sub-Lt. R.N.V.R....Alfred Banner.
William G. Willmott.
James L. A. Huggan.
Brian Rhys.
John C. F. Davidson.
Ralph C. Seal.
Sydney R. Gilbert.
(Gilbert Race.

2 Chief Writers (pened.).

Civil Staff.

6 Hired Extra Clerks, | 6 Higher Grade Women Clerks. | 2 Women Clerks.

ANTI-SUBMARINE DIVISION.

Director of the Anti-Submarine Division.....Captain William W. Fisher, C.B., M.C.O., R.N.
Assistant-Directors of the Anti-Submarine Division { Captain Forster D. Arnold Forster, C.B., R.N.
Captain Cecil H. Filcher, R.N.

Associates for Experiment and Research.

Professor W. H. Bragg, C.B., F.R.S.
Philip V. Hunter, Esq., M.I.N.E.

Naval Staff.

CaptainJohn W. Carrington, D.S.O.
Commander ...George B. Lewis.
John R. Middleton, D.S.O.
Edward H. Russell.
James S. Mel. Ritchie.
Henry L. Mitchins.
Henry H. Sawbridge.
Lieut. H. Horden (ret.).
Maurice G. Hamford.
Claude G. Dolson, D.S.O.
Charles D. Burney, C.B., R.N. (act.).
Lieut.-Com. ...Ernest R. Chong.
Stephen S. English.
Harold W. Morev.
Charles V. J. Norcock (ret.).
Teng, Captain...Henry W. Metcalfe (ret.).
Lieut.-Com. } Louis C. Bornaschi (act.).
R.N.V.R. } Tracy M. W. Wallis (act.).
Lieut.James T. Sloan.
Valentino G. G. Shortridge.

Lieut. } Cecil A. V. Roper.
R.N.V.R. } James C. B. Cairnt.
Reginald W. Jones.
Leonard C. Wain-Hatton.
Frederic Bacon.
Joseph Flimlinger.
Harold S. Sharp.
H. Russell-Jones.
Roger M. Lacey.
Thomas V. Hughes.
Paym. Lieut.- } Gordon Franklin.
Commr. (act.).
Paym. Lieut. } Henry J. Crane (act.).
R.N.R. } Stanley V. Moon (act.).
Sub-Lieut. } Oliver Holmes.
R.N.V.R. } George W. Knight.
Haoul S. B. Sargent.

Civil Staff.

Staff Clerks { W. G. Johns, Esq. (act.).
W. R. Hale, Esq. (act.).

2 Clerical Assistants.
 7 Temporary Clerks.

9 Women Clerks.
 2 Boy Clerks.

Chief Designer...A. R. H. Pew, Esq.

6 Draughtsmen. | 4 Inspectors. | 3 Tracers.

The following have been appointed or lent for Service during the War :

S. R. Blades, Esq., Malcolm H. Fiskine, M. A., Rev. R. Monclon Prichard, C. F. Scott, Esq. (U.S.A.).

Experimental Station, Parkston Quay, Harwich.

Research Staff.
Resident Director } Colonel A. B. Eve, C.B.E.,
of Research } M.R.S., D.S.O.
Deputy Resident } A. O. Rankine, Esq.,
Director of Research } D.S.O.
 (1. V. Dunsdale, Esq., D.S.O.
 F. B. Young, Esq., D.A.O., M.B.E.
 A. L. Hughes, Esq., D.S.O.
 R. W. Hoyle, Esq., D.S.O.
 H. Gerrard, Esq., M.B.E.
 L. S. Harbottle, Esq., D.S.O.
 F. L. Harwood, Esq., D.S.O.
 J. H. Powell, Esq., M.B.E.
 W. P. Hawthorn, Esq., M.B.E.
 A. B. Wood, Esq., M.B.E.
 H. R. Hives-Minto, Esq., M.B.E.
 H. B. Smith, Esq.
 J. T. Irwin, Esq.
 Capt. A. J. Rhodes, R.A.F., D.A.
 Capt. A. J. Roberts, R.A.F.
 Lieut. A. R. Wells, D.S.O.
 A. J. Jolley, Esq.
 H. B. Hood, Esq., D.S.O.
 R. S. J. Spillbury, Esq., D.S.O.
 W. Place, Esq., D.S.O.
 A. Gault, Esq., D.S.O.
 F. P. Hurst, Esq.
 W. Jeyson, Esq., M.B.E.
 Sub-Lieut. (1. P. Partidge, R.N.V.R., D.S.O.

J. Anderson, Esq.
 Capt. J. C. Manson, Can. Eng.
 Capt. R. H. Houlding, R.M., D.S.O.
 J. R. Milne, Esq., D.S.O.
 Lieut. W. Kerr, D.S.O.
 (1. Williamson, Esq., M.S.O.
 D. C. Dunbar, Esq.
 Lieut. R. H. Miles, C.B.E., D.A.
 Lieut. C. A. Wallace, R.M.
 Capt. H. C. B. Brown, D.A.

Executive Staff.

Superintendent.....Major J. H. W. Gill, R.E.
Electrical Eng. and } Capt. C. J. E. Concha,
Technical Assistant } R.M.
 Lieut. H. Lucas, R.N.V.R.
 Lieut. G. R. Wylie, R.N.V.R.
 Lieut. D. V. Hitchens, R.N.V.R.
 Lieut. H. Hamilton, R.N.V.R.
 C. Monkens, Esq. (*Works Manager*).
 O. F. M. Knight, Esq.
 1st Shipwright B. C. Staddon,
 W. W. Burgess, Esq. (*Technical Assist.*).
 A. L. Orchard, Esq.
 A. F. Turner, Esq.
 Eng. Lieut. (act.) H. J. Lyle, R.N.R.
 W. P. Yates, Esq.
 H. F. Kord, Esq.

MINESWEEPING DIVISION.

Director of Minesweeping.....Capt. Lionel G. Preston, R.E.
Assistant Director of Minesweeping.....Commander Henry M. J. Rumble, C.B.E. (act.)
Captain.....Hugh S. Curry, D.S.O.
Captain (act.) Harry P. Cayley, D.S.O. (ret.)
 (Lieut. (Ret.))
 Com. R.N.R.Reginald Salmon, D.S.O. (act.)
 (Temp.)
 Lieut. } Charles H. Powell.
 R.N.V.R. } 2 Temporary Clerks.

Lieut. } Arthur Scott-Elliott.
 R.N.V.R. } John W. Wooding.
 Lionel N. Sanderson.
 Paym. Lieut. } Reginald B. Ford. (act.)
 Com. R.N.R. }
 Temp. Sig. Boatwain George J. Dore (act.)
 2 Women Clerks.

MERCANTILE MOVEMENTS DIVISION.

Director of Mercantile Movements.....Capt. Frederic A. Whitehead.
Secretary to D.M.M......Paym. Lieut.-Commr. (act.) Paul B. Strickland.
Captain.....Bertram H. Smith.
 Walter J. O. Lako.
Commander.....John Kiddle.
 Cuthbert D. Longstaff.
Capt. R.N.R......Hubert W. Kenrick, C.B.E., D.P.
 (act. (ret.))
Lieut.-Com......Clarence B. Evans.
Lieut. R.N.R......James R. Harding.
Lieut. R.N.V.R......Arthur H. Churchill (temp.).

 Paym. Capt.H. W. Eldon Bullock, C.B.E. (act.)
 (Organising Manager of Convoy).
Commander.....Harold V. Dundas.
 Com. R.N.V.R.Henry D. King, D.S.O., V.D.
 Rollo Appleford.
Lieut.-Com......John O. Wyatt (ret.).
 Roland A. Clark.
Lieut.-Com. R.N.R......Henry Meltonkey.
Lieut......Geoffrey B. Bulton.
Lieut. R.N.R......William L. Wilson.

Lieut. R.N.V.R.Hubert M. Blandell.
 Thomas R. Westray.
 Geoffrey R. Gilbert.
 Alan P. Horbert.
 H. E. Ashley Sparks.
 Eng.-Commr.Francis J. Sutton.
 Insp.-Lieut.George S. McKensie.
 Paym. Lt.-Com.John M. Hodges.
 Paym. Lt. R.N.R.Philip R. Hutchinson (act.).
 Paym. Sub-Lt.Hubert G. Dickinson.
 R.N.V.R.Robert W. Carroll.
 W. J. Gregory.
 Thomas Shurall.
 Clifton Robbins.
 Robert P. White.
 William A. Hawke.

Captain.....Cuthbert R. Watson, C.B.E. (Capt. of Naval Tugs).
Commander.....Harvey R. G. Moore.
 John Horton (act.).
 Paym. Lt.-Com. R.N.R.Orrell Cox.

1 Minor Staff Clerk, 10 Temp. Clerks, 1 Boy Clerk, 12 Women Clerks.

Director of Air Division Temp'y. Dir. Gen. Robert M. Hoyt, C.O., D.S.O., A.F.C., R.A.F.	
Chief Assistant to D.I.D. W. A. Medlow, Esq., M.B.E.	
Lieut.-Col. C. H. K. Edmunds, D.S.O., T.A.F.	Temp'y. Captain. Alan M. Wadell, D.S.C., R.A.F.
Temp'y. Lieut.-Col. Lawrence T. Hutton, D.S.O., R.A.F.	J. Sherwood, D.A.I.
Temp'y. Major Reginald E. Nicoll, R.A.F.	P. S. Hargreaves, R.A.F.
S. J. Rutland, D.S.O., R.A.F.	Leonard E. Lander, R.A.F.
William C. Mickle, R.A.F.	R. Talboys, R.A.F.
Temp'y. Major..... Reginald F. Maitland, R.A.F.	
Henry A. J. Wilson, R.A.F.	
8 Temporary Women Clerks.	

Commander Harold G. Grenfell, R.N. | Major Roland M. Byne, O.B.E., R.M.
Paymaster Lieutenant (act.)...Herbert H. Sargent, R.N.R.

Appendix

NAVAL PUBLICITY DEPARTMENT.

Director of Naval Publicity ... Rear-Admiral Sir Guy R. A. Saurin, K.C.M.G., C.B.

Naval and Marine Staff.

Commander ... Colpoys C. Walcott (act.),
R. Gime Webb (act.),
Com. R.N.V.R. ... F. W. Bell, D.S.O. (act.),
Lieut.-Comdr. ... J. M. Hillland,
R.N.V.R. ... G. B. Beer,
Lieut. R.N.R. ... R. H. Goudon,
Lieut. R.N.V.R. ... R. T. Sullivan,
J. H. V. Crowder,
W. D. Smith,
R. H. Smith,
D. Maxwell.

Major R.A.L. ... F. M. Dood,
H. McEvoy,
G. Denis,
Lieut. R.M. ... Goudon H. Robinson,
Paym. Lieut.-Comdr. ... Collingwood J. Hughes,
R.N.V.M.,
Paym. Lieut.-R.N.R. ... J. P. Loughnan (act.),
H. Foster (act.).

(For *Grid Staff* see under *Intelligence Division*.)

The following have been appointed or lent for temporary service during the War :

Captain P. Command, C. Huchard, Esq., Sir J. Lavery, A.R.A., Glyn Philipps, R. G. Roberts, H. P. Wyndham Esq.

MATERIAL DEPARTMENTS.

DEPARTMENT OF THE CONTROLLER.

Third Sea Lord and Controller ... Commodore Charles M. de Bartolomeis, C.B.

Civil Assistant ... A. A. G. Champion, Esq., C.B.E.

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Director of Naval Construction ... Sir Eustace H. Tennyson d'Eyncourt, K.C.B.

Deputy Director of Naval Construction ... W. H. Gaird, Esq., C.B.E., D.S.O. (act.).

Assistant Directors of Naval Construction ... T. Dally, Esq., C.B.E., (act.) (Superintendent of Naval Construction), A. W. Johns, Esq. (act.), J. H. Smith, Esq., M.V.O. (act.), H. Pledge, Esq., C.B.E., A. B. Richmond, Esq.

Superintendent of Admiralty Department Works ... H. E. Frondo, Esq., C.B.E., LL.D., F.R.S.

Chief Constructors.

H. L. Atwood, D.S.O., (act.),
M. E. Bayland, C.B.E., (act.),
F. Bryant, C.B.E., (act.),
A. J. Hobson (act.),
C. F. Munday,
M. E. Payne (act.),
D. A. Payne (act.),
P. A. Pollock, Esq.,

Assistant Constructors, First Class.

T. H. Hentlow (Overseeing),
E. S. Gimphey (Overseeing),
W. Frondo (Master),
G. Mackney (Overseeing),
W. H. Wallcut, Esq.,

Constructors.

G. A. Bamsett (act.), (Overseeing),
C. M. Carter, M.B.E., (act.),
F. B. Charlis (act.),
G. H. Child (act.),
S. V. Goodall, M.B.E., (act.), (Temporary detached),
C. Mansford (act.),
H. B. Harries (act.),
F. Hickey (act.),
C. J. W. Hopkins (act.),
A. H. Morley (act.),
C. W. Kerridge (act.),
J. M. Leo (act.),
G. S. Lillieard, M.B.E., (act.),
W. J. Martin,
T. S. Mathias (act.),
E. D. Moryon (act.), (Overseeing),
A. Nicholls (act.),
W. K. Noble (act.),
R. P. Pether (act.), (Overseeing),
W. G. Sanders (act.),
A. W. Watson (act.),
L. C. Williamson (act.),
T. Woodard, Esq.,

Assistant Constructors, Second Class.

F. T. Mackman,
W. A. D. Forbes,
G. W. L. Gwyn,
G. McGhie,
J. G. F. Moon, Esq.,

Temporary Constructor ... D. E. Hill, Esq. (Overseeing).

Temporary Assistant Constructors.

A. G. Aikster, B.Sc.,
J. Angus, D.S.O.,
C. W. Blon, B.Sc.,
J. L. Champness, B.Sc.,
F. C. Cocks,
D. A. Cookery, B.Sc.,
J. L. Davies,
R. Farley,
T. Graham, B.Sc.,
W. R. Hookaday,
Capt. R. S. Johnson,
A. E. Kimberley,
M. M. Parker,
G. McL. Paterson, B.Sc.,
A. P. Patterson, B.Sc.,
P. G. Rouse, D.A.,
J. H. Sowden, B.Sc.,
T. B. Sowden, B.Sc.,
J. C. M. Wilson, Esq.,

Temporary Acting Assistant Constructors.

T. Burch.
G. Chapp.
J. S. Clark.
W. H. Eastcott.
F. T. W. Harris.

R. J. Homwell.
W. H. Humphrey.
F. Hummels.
J. C. W. Hutson.
W. J. Loughton.
W. E. Macoy.

P. J. Farmer.
G. B. Peach.
G. Pennov.
A. F. Perkins.
H. Philpot.

G. H. Smith.
A. Taylor.
A. F. Thorp.
A. Warren.
G. H. Whiteway, Esqrs.

Temporary Assistant... D. W. Dana, Esq., O.B.E., M.A.
Inspecting Officer of Ship Fitting Work... S. A. Truscott, Esq.

Inspecting Officer of Smiths' Work... E. T. Peniston, Esq.

Inspector of Drawings... W. J. Moore, Esq.

Confidential Clerks to D.N.C.... J. Luffman, Esq.

F. O. Bamford, Esq. (act.).

Technical Clerk to D.N.C.... W. H. Malpas, Esq.

54 Principal and 302 Assistant Overseers

120 First Class and 91 Second Class Draughtsmen, 1 First and 1 Third Grade Dockyard Clerks, 9 Men and 30 Women Typists and Clerks, 1 Boy Clerk, 4 Modellers, and 2 Superintendents.

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Director of Electrical Engineering... O. H. Worthington, Esq., O.B.E., M.I.E.E., M.I.M.E., M.I.E.E.

Assistant Directors of Electrical Engineering... A. D. Constable, O.B.E., M.I.E.E. (act.) and

R. T. Williams, M.I.E.E. (act.), Esqs.

Electrical Engineers, Higher Grade... F. P. Fletcher, O.B.E., M.I.E.E. (act.) and

R. Wightman, M.I.E.E. (act.), Esqs.

Electrical Engineers, Lower Grade... H. Melville Ackery, M.I.E.E., F. C. Forster, M.I.E.E., H. R. Green, M.I.E.E. (act.), W. P. Scott, M.I.E.E. (act.) and H. H. Stratton, M.I.E.E. (act.), Esqs.

Temp. Electrical Engineers... A. Dunne, M.I.E.E., M.I.M.E., J. Brodie, F. Morton, M.I.E.E.,

J. Shepherd, M.I.E.E., M.I.M.E., J. M. L. Slater, R. W. White, and A. E. Wilson, Esqs.

First Assistant Electrical Engineers... A. W. Abraham (act.), E. C. Allen (act.), F. Amor (act.), G. W. Braby (act.), W. H. Chatten (act.), W. M. Couch (act.), H. E. J. Marks (act.), T. Pedrick (act.), J. Shaw, M.I.E.E.,

(act.), W. J. Spencer (act.), and L. A. Tippet (act.), Esqs.

Temp. First Assistant Electrical Engineers... M. R. Gardner, P. L. Gill, M.I.E.E., T. D. Trees and W.

Simpson, Esqs.

Technical Secretary... F. Morton, M.I.E.E., Esq.

10 Principal Electrical Overseers, 108 Assistant Electrical Overseers.

9 First Class, 9 Second Class, and 12 Temporary Draughtsmen, 6 Women Tracers,

8 Temp. Clerks, 11 Women Clerks and 3 Boy Clerks.

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Engineer-in-Chief of the Fleet... Eng. Vice-Admiral Sir George C. (Goudin), K.C.B.

Deputy Engineer-in-Chief and Superintendent of Naval Engineering...

Eng. Rear-Admiral Edward Goudin, C.B.

Assistant Engineer-in-Chief... Eng. Captain Charles W. J. Hearlock, C.B. (temp.).

Eng. Captain John McLaurin.

Eng. Captain Edward Short (ret.) (temp.).

Engineer Inspectors.

Eng. Captain David J. Harruthers.
Frederick W. Marshall.

Eng. Commander Charles C. Green, C.B.

Arthur B. Llyso.

Eng. Commander Joseph J. Kirwin, O.B.E.

John Hamilton.

Thomas G. Proctor.

William S. Mann.

Robert Bowman.

Jesse H. Harlan.

Ernest Nibbs.

Frederick J. Pedrick.

Alfred Turner.

James Leggett.

Eng. Lieut.-Com. Edward P. St. John (ret.) (act.).

Harold B. Tostevin, D.S.O.

Examiners of Marine Engineering Work... H. Goodchild (act.), J. Hocking (act.), J. G. Newton (act.),

J. P. M. Parkinson (act.), D. Russell (act.), A. J. Smith (act.), Esqs.

Examiner of Dockyard Work... D. Page, Esq. (act.)

Examiner of Engineering Accounts... F. W. Holterley (act.), Esq.

Confidential Clerk to E.-in-C.... W. J. Pasir, Esq. (act.).

10 1st Class Draughtsmen, 21 2nd Class Draughtsmen, 14 Temporary Draughtsmen, 2 Dockyard Clerks,

1 Mixed Writer, 6 Temporary Clerks, 2 Extra Clerks, 22 Women Clerks, 2 Boy Clerks.

Admiralty Engineering Laboratory, City and Guilds (Engineering) College, Exhibition Road, S.W.7.

Superintendents... Eng. Commander Charles J. Hawkes, R.N.

Chief Designer... A. W. Newman, Esq.

Metallurgist... F. H. Hudson, Esq.

Testing Engineer... J. Atkin, Esq.

(There were a number of Associates for Experiments and Research).

ENGINEER OVERSEERS AND LIST

At Messrs. Armstrong, Whitworth & Co., Walker Lane, Newcastle upon Tyne (for R.N., "Engl.")
Eng. Capt. W. T. Mitchell, R.N.

BRISTOL AND MIDDESEXPORT AND HAMMERTON DISTRICT
Eng. Capt. R. B. (Hudd), R.N. Address—c/o Messrs. Doyland & Son, Sunderland
Eng. Lieut. C. J. Brown, R.N. (ret.)
 10 Civil Assistants and 2 Clerks

LONDON DISTRICT
Eng. Capt. J. May, R.N. Address—6, New Road, Ebbw Vale
 6 Civil Assistants

At Parkfield Shipbuilding Co., Glasgow and Clyde 1 Shipyard, Troil
Eng. Capt. G. H. Knight, R.N. Address—c/o Messrs. Luffell, Cowan
 11 Civil Assistants and 1 Clerk

BARROW IN FURNES DISTRICT (AND MURRAY DISTRICT, CANTON AND MURRAY)
Eng. Capt. H. B. Lytle, R.N. Address—c/o Messrs. Vickers & Co., London
Eng. Lieut. J. W. Tomlinson
Lieut. John C. J. Beckwith, R.N.
 3 Civil Assistants and 2 Clerks

At Messrs. Palmer, S. & J., Taithe Lane
Eng. Capt. W. Walter, R.N.
 6 Civil Assistants

At Messrs. Beardmore & Co., Dalmuir, and Messrs. Denny & Co., Dumbarton
Eng. Capt. J. H. Lounie, R.N. Address—c/o Messrs. Beardmore & Co., Dalmuir
Eng. Lieut. Com. H. Townhill, R.N.
 9 Civil Assistants and 2 Clerks

GLASGOW DISTRICT
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 3 Civil Assistants and 1 Clerk

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Eng. Capt. G. T. R. H. P. N. Address—Quebec Chambers, Quebec Street, Leith
Chief Eng. J. Downie, R.N.
 6 Civil Assistants and 1 Clerk

MIDLAND DISTRICT
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Eng. Lieut. Com. A. J. R. Northcott, R.N.
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 Woodston, Nottingham
Eng. Lieut. M. J. Spence, R.N.
Eng. Lieut. A. Sherriff, R.N.
Eng. Lieut. R. J. Pearson, R.N.
 11 Civil Assistants and 1 Clerk

At Messrs. Hawthorn, Leslie & Co., St. Peter's Works, Newcastle upon Tyne
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Eng. Lieut. J. A. Reynolds, R.N.
Eng. Lieut. C. I. Walton, R.N.
 8 Civil Assistants and 3 Clerks

At Messrs. Babcock & Wilcox, Renfrew
Eng. Capt. H. D. H. Ash, R.N.
Chief Eng. J. H. Carter, R.N.
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SCOTLAND DISTRICT

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Eng. Com. J. Maxwell.
Eng. Lieut. D. R. McFarlane, R.N.
Eng. Lieut. R. A. Denny, R.N.
Ch. Artf. Eng. W. Shakespeare, R.N.
 11 Civil Assistants and 3 Clerks

At Messrs' Strath Turbine Co. and North British Marine Eng. Co., Wallsend-on-Tyne
Eng. Capt. C. H. Hill, R.N. Address—c/o Messrs. Parsons' M.S.T. Co., Wallsend-on-Tyne
 4 Civil Assistants and 1 Clerk.

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 4 Civil Assistants and 1 Clerk.

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 4 Civil Assistants and 1 Clerk.

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Eng. Capt. H. C. Bath, M.I.O., R.N. Address—c/o Messrs. Brown Bros., Rosebank Ironworks, Edinburgh.
 2 Civil Assistants and 1 Clerk.

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Eng. Capt. R. S. Silk, R.N. Address—c/o Messrs. Yarrow & Co., Scotstoun.
Artf. Eng. J. H. Smith, R.N.
 2 Civil Assistants.

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Eng. Capt. H. W. Irish, R.N. Address—21, Odlingswood Buildings, Newcastle-on-Tyne.
 7 Civil Assistants and 2 Clerks.

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Eng. Lieut. W. J. Hamblay, R.N. (ret.).
Eng. Lieut. A. T. Lloyd, R.N. (ret.).
 4 Civil Assistants and 1 Clerk.

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Eng. Capt. W. C. S. P. Bathrell, R.N. Address—c/o Messrs. Scott's, S. & L. Co., Glasgow.
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At Wallsend Shipway & Eng. Co., and Messrs. Swan, Hunter, & Wigham Richardson, Wallsend-on-Tyne.
Eng. Capt. G. F. Thompson, R.N. Address—Wallsend Shipway Co., Wallsend-on-Tyne.
Ch. Artf. Eng. M. R. Oliver, R.N.
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Eng. Capt. E. H. Bond, C.M.G., D.S.O., R.N. Address—37, Arcade Chambers, St. Mary's, Gate, Manchester.
Eng. Lieut. T. Williams, R.N.
Ch. Artf. Eng. B. Booth, R.N.
 5 Civil Assistants and 1 Clerk.

LIVERPOOL DISTRICT.

Eng. Capt. T. B. Huddy, R.N. Address—c/o Messrs. Cammell Laird & Co., Birkenhead.
Eng. Lieut. R. T. Itder, R.N.
 9 Civil Assistants and 1 Clerk.

At Messrs. J. Brown & Co., Cludebank.

Eng. Commr. A. T. H. Stone, R.N.
Artf. Eng. A. Ashbury, R.N.
J. B. Gibbs, R.N.
F. W. Oldreive, R.N.
 3 Civil Assistants and 2 Clerks.

Appendix

At Messrs. Armstrong, Whitworth & Co., Newcastle-on-Tyne. (for Submarines).

Eng. Commr. R. Spence, R.N.
3 Civil Assistants and 1 Clerk.

SHARPTON DISTRICT.

Eng. Commr. Mark Rundle, D.S.O., R.N. Address—123, Surrey Street, Finsfield.
Eng. Lieut.-Com. H. Batey, R.N.
Lt. Jackson, R.N.
3 Civil Assistants and 1 Clerk.

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Eng. Capt. T. H. Farnor, R.N. Address—c/o Messrs. Rindon, Proctor & Co., Lincoln.
Eng. Lieut. W. C. Williams, R.N.
Q. Marchant, R.N.
Atst. Eng. J. M. Holley, R.N.
2 Civil Assistants and 2 Clerks.

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Eng. Commr. J. L. A. Fisher, R.N. Address—c/o Messrs. Williams & Robinson, Ltd., Rugby.
Eng. Lieut. C. Davidson, R.N.
3 Civil Assistants and 1 Clerk.

At Messrs. Armstrong, Whitworth & Co., Naval Yard, Walker-on-Tyne (for Machinery Dept.).

Eng. Commr. T. Soper, R.N.
Atst. Eng. W. Williams, R.N.

At Messrs. Pickers, Barrow-in-Furness (for Submarines).

Eng. Commr. H. W. Grant, R.N.
Temp. Eng. Lieut. P. B. Oram, R.N.
5 Civil Assistants and 2 Clerks.

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W. Lelly, Esq. Address—120, Wootton Road, Haresden, N.W.10.
3 Civil Assistants and 1 Clerk.

LONDON DISTRICT, III.

M. C. Ord, Esq. Address—270, Trinity Road, Wandsworth, S.W.18.
3 Civil Assistants and 3 Clerks.

P. T. Welland, Esq., Principal Boiler Overseer. Address—172, Rotton Park Road, Edgbaston, Birmingham.

DEPARTMENT OF THE DIRECTOR OF NAVAL ORDNANCE.

Director of Naval Ordnance.....Captain Henry R. Crooke.

Assistant-Director of Naval Ordnance...Captain Joseph C. W. Henley.

Assistants to Director of Naval Ordnance.

Commander Bernard W. M. Fairbairn.
Rustace R. D. Long.
William H. O. Ross (act.).
(C) Stanley T. H. Wilton.
(G) Gerald F. Longhurst, D.S.O.
(G) John G. Hamilton.
Philip W. Douglas.
Archibald Gilbert (act.).

Commr. R.N.V.R. John G. Henderson (act.).
Lieut.-Com. Dennis H. Edlilly.
Lieutenant Frederick J. Payne.
Malcolm A. McKensie.
Lieut. R.N.V.R. William D. Kilroy (temp.).
William D. S. Faulkner.
Lieut. R.N.V.R. ...Michael P. B. Dalton.

Chief Gunner...Herbert D. Jehan.

Commissioned Armourer...Ernest Addy.

Engineer Inspectors.

Eng. Captain..... Henry Wall, C.M.G.
Eng. Commander ... William Hart.
Walter G. Hoppel.

Eng. Commander ... Frederick C. R. Paton (temp.).
F. Leslie Robertson.
Eng. Lieut.-Com. ... Stanley W. Cooke.

Measurer of Gun-Mounting Accoutrements...A. H. Duffield, Esq. (act.).

Examiner of Gun-Mounting Work...W. E. D. Holmer, Esq. (act.) (temp.).

Chief Inspector of Naval Ordnance...Commander (act.) John A. Duncan, C.B.

Assistant Chief Inspector of Naval Ordnance...Commander (act.) John A. L. Hay.
Assistants to Chief Inspector of Naval Ordnance...Commander Henry G. H. Bevan (ret.).

Commander Ralph G. D. Duffield.
Commander Leslie J. L. Hammond (ret.).

Commander John M. Bray (ret.).

Commander Reginald G. B. Carey-Bronton (emeryn).

Commander Percy Harvey (ret.).

Major; Freeman C. N. Bishop, R.M.A.

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The following gentlemen have been lent for special service during the War—G. A. Reed, W. Pettit, and J. Storey, R.N.D., Esqrs.

Naval Officers employed on Inspection and Experimental Ordnance Duties.

Under Chief Inspector of Naval Ordnance:—

Inspector of Steel...Commander Harold G. Jackson (ret.).

Acting Inspector of Steel...Commander (act.) Edward R. H. Newlyn (ret.).

Deputy Inspectors of Steel...Colonel J. R. J. Jocelyn, R.A. (ret.) (temp.).

Colonel W. H. Williams, C.M.G.

Commander Hugh J. Orr (ret.).

Commander Henry Thompson (ret.).

Lieut.-Com. Arthur W. Tomlinson.

Lieut.-Com. Frank R. Willis.

Lieut.-Com. John G. M. McFarley (ret.).

Lieut.-Com. Robert F. Veasey (ret.).

Major R. M. A. Charles A. Bishop.

Major R. M. A. Alfred D. B. Goddard.

H. Topham, R.N.D., Esq.

W. R. C. Hooking, Esq.

Head of Inspection of High Explosive Section...Thomas J. G. Gough, Esq.

Assistant Inspectors of Steel.

Major-General J. T. J. Johnson, C.B. (ret.) (temp.).
Charles L. Gordon, M.B.E. (ret.) (temp.).
A. B. Marchant, C.B. (ret.) (temp.).
W. Tholeston, C.M.G., R.N. (ret.) (temp.).

Major-General H. B. Millar, C.B. (temp.).
G. Treville Harston, Canadian Forces (temp.).
O. M. H. Thackwell, R.N. (ret.) (temp.).

Captain H. R. Evans, R.N. (ret.) (temp.).
William H. F. Taylor, R.N. (ret.) (temp.).
N. G. Macalister, R.N. (ret.) (temp.).
Roland Berkeley, R.N. (temp.).
George F. S. Knowling (ret.) (temp.).

Commander Charles K. McCallum (ret.) (temp.).
T. S. Jooch (temp.).
A. H. Tremayne (ret.) (temp.).

Commander R. N. E. W. F. Caborn, C.B., R.N. (ret.) (temp.).

Lieut.-Com. Allister W. McDonald (ret.) (temp.).
Ralph B. Roddy (ret.) (temp.).
Henry L. Weston (temp.).
Frederick J. Davis, R.N., M.B.E. (ret.) (temp.).
W. M. (temp.).
W. H. G. (temp.).
John L. C. Odliv (temp.).

Lieut. William Pollington (ret.) (temp.).
George R. Fraw (ret.) (temp.).
Robert J. Sweet (ret.) (temp.).

Lieut. R. N. B. Beauchamp H. Vennor (ret.) (temp.).

Ensign Capt. William J. Brown (ret.) (temp.).

Ensign Com. H. F. Davies, R.N. (ret.) (temp.).

King. Lieut.-Com. T. F. Brown (ret.) (temp.).

Colonel (temp. Brig.-Gen.) Cooper Penrose, R.N. (temp.).

Colonel C. L. Robinson (ret.) (temp.).

H. D. Oliver (temp.).

D. A. Mills, R.N. (ret.) (temp.).

A. L. M. M. M. (ret.) (temp.).

M. H. Purcell, R.N. (ret.) (temp.).

C. B. Nairnes, C.B., R.N. (ret.) (temp.).

W. J. Hawkins, R.N. (ret.) (temp.).

R. A. Inglis, C.M.G. (ret.) (temp.).

J. V. Jolliffe, R.N. (temp.).

Br. Col. H. V. Thornton, R.A. (temp.).

H. O. Nelson, R.A. (temp.).

Lieut. Col. F. H. Elliot, C.B., I.A. (ret.) (temp.).

Alban Wadhwa (temp.).

A. Trosby (temp.).

H. C. Evans, R.M.L.I. (temp.).

P. O. Beale (Indian Army) (ret.) (temp.).

Major & Lt. Col. Frederick L. Diblee, R.M.A.

Major R. F. Fitzgerald-Lombard (ret.).

B. Nash, R.A. (ret.) (temp.).

Captain G. B. Macpherson Grant (temp.).

A. J. Beckett, R.N. (temp.).

C. A. Pettit, R.O.V.C. (temp.).

T. S. Bowen (Welsh Regt.) (temp.).

G. B. Balmforth, C.B.E., R.N. (temp.).

Lieut. D. E. Horwood, R.A. (temp.).

C. W. Wedekind, R.N. (temp.).

Chief Gunner William J. Bousley (temp.).

Albert G. T. Brown (temp.).

Gunner (ret.) Richard W. Lawrence.

George B. Cook (temp.).

Daniel J. O'Leary (temp.).

Frederick J. Lawcombe (temp.).

James C. Harcourt (temp.).

John B. Cobb (temp.).

The following gentlemen have also been appointed for temporary service during the War:—

R. W. Archer, H. A. Armstrong, F. H. Belgrave, T. J. Bell, A. T. Blundell, G. B. Bowell, Prof. T. J. Brown, F.R.S., C. B. Buchan, H. Burdell, V. Cameron, A. G. Cameron, E. B. Cole, M.B.E., J. E. Cunningham, H. W. H. Durrant, F. H. Deane, A. H. Dodd, J. A. Dorn, P. J. East, H. R. Felix, J. Ford, S. B. Fox, J. Frondo, R. P. Gibson, H. C. A. Goodall, C. F. Green, A. P. Grenfell, L. T. Jarvis, A. Johnson, J. L. Kitch, K. M. W. Knights, E. Lako, J. L. Lamb, A. R. Lee, A. J. Llewellyn, A. H. Macdonnell, B. Maslin, J. Maxwell, E. Moffat, W. N. Moleworth, G. H. Moore, A. S. Moss-Blundell, F. O. Murray, W. Musk, A. S. Napier, T. J. C. Pallen, W. P. Ray, R. Percival, D. Ploton, P. Richard, G. Weston Ramsey, G. H. S. Rollison, T. W. Shoppard, S. Sherrin, J. W. Slater, R. W. Smith, J. B. Sumner, E. L. Trench Watson, J. T. Tunnah, R. H. Voica, A. Wasey, G. H. Wells, J. Winn, H. Wontner-Smith, C. H. Wright and J. H. Wright, Esqrs.

Appendix

Left from Home Office.

S. R. Bennet, A. C. Lowe, C. C. Sumner, E. L. Meekins, C. E. Hunter, W. H. Mord, W. Tinner, A. A. Hopburn, C. H. Taylor, C. E. Plumb, A. Petheringham, H. T. Kempe, and W. C. Evans, Esqrs.

J. H. C. Newby, Esq., *Deputy Clerk (act.)* under the Inspector of Steel, Sheffield,
(sent from the National Insurance Comm.).

G. Price, Esq., Act. Asst. Clerk under the Inspector of Steel, Sheffield.

Under Home Office.

Comdr. Archibald G. Gooden (act.) (ret.). | Major (Pompy. Lieut.-Col.) Nathaniel P.
Major R. M. L. Henry K. Stephens. | Tindman, R.M.A.

The following gentleman has been appointed for temporary service during the War :
H. Jackson.

Superintendent Clerk...Thomas G. Anderson, Esq., O.B.E.

Deputy Superintending Clerk...W. P. Dumbly, Esq. (act.).

Assistant Superintending Clerks...A. C. Jones (act.), G. D. McFarlane (act.), S. W. Smith (act.), G. Stevens (act.), and G. H. Webb, Esqrs.

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Superintendent of Ordnance Stores...Captain Herbert R. Norbury, R.N.

Deputy Superintendent of Ordnance Stores...H. Petheris, Esq., F.S.O. (act.).

Assistant Superintendents of Ordnance Stores...A. McFarlane, Esq., O.B.E. (act.),
W. A. Mortimer, Esq. (act.),
R. W. Whithurst, Esq. (act.).

Naval Ordnance Store Officers...J. Platt, R.N. (act.), W. H. Rowe (act.), N. Thomas (act.), and
W. Vaughan (act.), Esqrs.

Deputy Ordnance Store Officers...W. J. Ryan (act.), H. G. Hubbard, R.N. (act.),
G. H. Murray (act.), A. T. Reed (act.), E. L. Tounley (act.), and
J. A. Vignaux (act.), Esqrs.

Assistant Ordnance Store Officers...W. Baker (act.), A. H. Beard (act.), R. J. Fidler (act.),
H. Harrison (act.), W. R. Harrison (act.), W. A. Judd, Esq.,
L. A. Kitching (act.), E. W. Lambie (act.), W. Maughan (act.),
B. T. Matthews (act.), G. A. Nispe (act.), H. B. Piddim (act.), H. D. Robbins (act.), G. Sainsford (act.),
and H. Wens (act.), Esqrs.

Temporary Assistant Ordnance Store Officers...A. J. Atkins, Esq., Capt. H. B. Batley, F. (Italian)
Brown, E. Durrant, W. Goucher, Esqrs., Capt. H.
G. Loring, H. P. Miller, Esq., Capt. G. D. Marshall
S. Smith, and G. Uppelby, Esqrs.

Chief Examiner of Naval Ordnance Work...P. J. Payne, Esq. (act.).

Examiners of Naval Ordnance Work...W. H. Evans (act.), G. Harrison (act.), and
G. Vinson (act.), Esqrs.

9 Ordnance Depot Clerks, First Grade (act.).

7 Ordnance Depot Clerks, Second Grade (act.).

1 Ordnance Depot Clerk, Third Grade.

1 Ordnance Depot Clerk, Third Grade (act.).

70 Temporary First Extra Clerks.

57 Temporary Women Clerks.

15 Boy Clerks and Boy Writers.

Acting Deputy Ordnance Store Officer—Sheffield...G. Swift, Esq.

Acting Assistant Ordnance Store Officer—Sheffield...J. Oswald, Esq.

Chief Analyst—Sheffield...John G. W. Munro, Esq.

NOTE.—Officers of the Naval Ordnance Department serving at Woolwich and at the Ports are not shown.

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Director of Torpedoes and Mining...Captain Frederick L. Field, R.N., Adm.

Assistant Director of Mining...Captain Herbert N. Garnold, R.N.A.

Assistant Director of Torpedoes...Captain Algernon H. G. Hardy.

Assistant Director Electrical Section...Captain John K. Im Thurn.

Assistant Director of Paravanes...Captain (act.) George L. Massey.

Naval Staff.

Vice-Admiral ... R. S. Philippe-Rouby, *C.V.O.*
Captain Bryan G. (Godfrey-Faussett,
C.V.O., C.M.A. (ret.)
Captain (act.) ... Edgar R. Mount, *D.V.O.*
Commander... .. Godfrey C. Cundy,
 Thomas L. Fford,
 Aschbald A. Lovett-Cameron,
 Edward W. MacKiehan,
 William B. MacKiehan (b),
 Stephen D. Millard,
 Brian Rington,
 Ralph Leatham,
 Karl L. Wharton,
 Malcolm K. Hunt (*ret.*),
 Gerard B. Riley (*ret.*),
 Robert J. Howard (*ret.*),
 Robert W. Dalgety, *D.S.O. (ret.)*,
 Noel A. Marshall (*act.*) (*ret.*),
Lieut.-Commr.... .. Bertram Vigne,

Lieut.-Commr. .. Rodolph H. F. de Salla, *D.S.O.*,
 George F. S. Howles (*ret.*) (*act.*),
Lieutenant Patrick P. Coleman,
 Harry Simson,
Lieut. R.N.R. ... Cyril Smith,
Lieut. R.N.V.R. Thomas J. Gibson,
 Edward W. Taylor,
 Norman W. Piesnell,
Eng. Commr.... .. Edward G. Heford,
 Alfred R. Kempf,
Lt.-Col. R.M. ... Chetwode G. C. Crawley,
Paym. Sub- }
Lieut. R.N.V.R. } Edwin M. Lawson,
 (For duty with *D.D.M.*)
Ch. Gunner James Wood,
 Leonard Repton,
 Walter Thorogood,
 Walter F. Williamson,

Captain of Defensive Mining Captain Gordon (J. Fraser (*ret.*),
Assistant to Commander H. Strickland (*ret.*),
Lieut.-Com. Francis T. Newson,

SEARCHLIGHT PARTY.

Warrant Electrician .. Albert B. Williams,
 George Hayson,

Warrant Electrician.. Sydney H. Brown (*act.*),

Civil Staff.

Superintending Clerk (act.) P. B. Courtin, Esq., *M.B.E.*
Deputy Superintending Clerk (act.)..... F. Morrison, Esq.,
Assistant Superintending Clerks (act.)..... H. Beeman and E. Tilles, Esqrs.,
Examiner of Torpedo Tubes (act.)..... B. Woollard, Esq.,
 2 Dockyard Clerks, 100 Clerks (*act.*), 6 Draughtsmen, 2 Women Tracers, 6 Temporary Men Clerks,
 28 Temporary Women Clerks and Typists, 1 Boy Clerk.

The following gentlemen have been appointed for temporary service during the War:—
Inspectors of Wireless Telegraphy in Auxiliary Patrol Vessels... J. J. Capes and P. H. Courser, Esqrs.

Lent by War Office for Special Duty... Captain A. M. Low, *R.A.F.*
 The following gentlemen have been appointed for temporary service:—
Superintendent Inspectors... J. C. Ashby and Lieut. C. L. Trevelyan,
Chief Inspectors... Dr. J. W. Canstick, Lieut. E. Edwards and Lieut. J. T. Jenkins,
Inspectors... D. S. Ashby, W. B. Hall, F. B. Colver, T. A. Daniel, T. T. Fawcett, T. R. Freeman, H. J. Holmes, H. J. C. Ivelton, H. H. Kirby, J. McKellar, Lieut. J. McQueen, V. F. Murray, W. W. U. Ross, A. R. Holt, W. G. Spencer, and J. E. T. Young, Esqrs.

MINES INSPECTION STAFF.

Head Office—47, Victoria Street, S.W.1.
Head of Mines Inspection Dept. (H.M.I.D.)..... Eng. Captain William R. Parsons, *C.B.D., D.S.O.*
Chief Inspector of Mines William S. Prince,
Secretary to H.M.I.D...... Miss M. M. Richards, *Asst. Principal, W.N.S.A.*

TECHNICAL STAFF.

Charge Inspectors... W. A. Stephens, C. Souress, J. K. Green and R. S. Brown.
Assistant Inspectors... Lieut. R.N.V.R. J. Stephens, C. Vincett, H. M. Andrews, and Gunnr (T) E. A. McGill (*ret.*),
Examiner of Mining Records (act.).. W. H. Collins, Esq.,
 2 Draughtswomen, 4 Typists, and 6 Lady Clerks.

Divisional Inspectors of Areas.

A. G. Flint, Esq. (*Portsmouth*).
 J. T. Pimble, Esq., (*North of England*).
 E. S. Atherton, Esq. (*Yorks.*).
 J. Ormond, Esq. (*Lincoln*).
 J. Ward, Esq. (*Colchester*).
 J. Marsden, Esq. (*Birmingham*).
 J. Marshall, Esq. (*Birmingham*).
 Eng. Capt. (*ret.*) J. K. C. Moore, *D.S.O.* (*Bath*).
 E. R. Lewis, Esq. (*South Wales*).
 J. Haverley, Esq. (*Manchester*).
 E. Chichester, Esq. (*Manchester*).
 W. S. Gibson, Esq. (*Gloucester*).

W. Salter, Esq. (*East Scotland*).
 W. Hill, Esq. (*Oxford*).
 C. O. Hillsdon, Esq. (*North-East London*).
 J. T. H. Miles, Esq. (*South and South-West London*).
 H. W. Oakley, Esq. (*North and North-West London*).
 J. Chadstone, Esq. (*Eastbourne*).
 A. Grant, Esq. (*Crayford*).
 W. Johnston, Esq. (*Strangmouth*).
 R. J. Potter, Esq. (*Warrington*).

Appendix

TORPEDO STORE DIVISION.

Superintendent of Torpedo Stores.....	Frederick Ward, Esq.
Assistant Superintendent of Torpedo Stores.....	T. W. Aldinger, Esq.
Torpedo Store Officers.....	J. A. W. Ballard, Esq., M.D.E. (act.). C. C. Casens, Esq., M.D.E. (act.).
Deputy Torpedo Store Officers.....	J. A. Jeffrey, Esq., (act.). P. Stokes, Esq. (act.).
Assistant Torpedo Store Officers.....	W. Evans, Esq. (act.) (temp.). J. Gray, Esq. (act.). C. Heron, Esq. (act.). W. P. Treuery, Esq. (act.).
Technical Assistant	Eng. Lieut. Vincent P. Baughop (temp.).
	3 Torpedo Depot Clerks, First Grade (act.).
	3 Torpedo Depot Clerks, Second Grade (act.).
	3 Torpedo Depot Clerks, Third Grade (act.).
	13 Temporary Mixed Extra Clerks.
	15 Temporary Women Clerks.
	1 Established Woman Clerk (on loan from H.M.O.H.).
	7 Boy Clerks and Boy Writers.

Officers of the Salvage Department accommodated in the War College were shown under H.M.S. Vernon.

DEPARTMENT OF THE DIRECTOR OF NAVAL EQUIPMENT.

Director of Naval Equipment.....	Rear-Admiral Edward M. Phillips, C.B.
Assistant Director of Naval Equipment.....	Captain Percy Withers.
Captain.....	Alexander Farrington.
Commander.....	George H. H. Holden (ret.).
	Alec Stokes.
	Henry P. H. Wakefield (temp.).
	John D. Chambliss, D.S.O.
	(temp.).
	Archibald D. I. MacLennan
	(temp.).
	Edmund L. H. Lockyer, D.S.O.
	(ret.) (act.).
	10 Lieutenants R.N.V.R. for work at Outposts.
1 Dockyard Clerk (Second Grade).	1 Higher Grade Woman Clerk.
2 Modelmen.	1 Woman Modeler.
	15 Temporary Women Clerks.
	Shipwright Lt. Thomas E. Soper.
	John W. Williams, D.S.O.
	Arthur P. Crawford (act.).
	Herbert O. Mark.
	Alfred J. Parkes.
	Cecil W. Bateson.
	Frank S. Moss.
	Charles J. M. Wallace.

SALVAGE SECTION.

Head of Salvage Section.....Hon. Captain Fred W. Young, C.B., M.C.M., R.N.R.

Naval Staff.

Flag Capt.....	Henry R. Towl (ret.).
Commander.....	James H. Bullock (ret.).
Commander.....	Charles C. Talbot, D.S.O.
R.N.R.	John Viner, D.S.O.
Paym. Com.	Arthur W. B. Messenger.
	Lieut. Harry Salmon (act.).
	Edward Smith (act.).
	Matthew Rush.
	Fred Treuery.
	William J. Perry.

Civil Staff.

Salvage Finance Officer.....Fred. H. Lowe, Esq.
Salvage Accounts Officer.....C. T. Jones, Esq. (act.).
C. Bullock, Esq. (act.).

3 Second Grade Clerks, 5 Temporary Clerks, and 12 Temporary Women Clerks.

Salvage Officers.

Commander.....	Anthony C. C. Dainton (act.) (ret.).
Commander.....	James W. Greig (act.).
R.N.R.	Charles K. Tuckwell (act.).
	Ivan J. Kay (act.).
	George Davis (act.).
	George J. Wheeler (act.).
Commander.....	Herbert R. Match (act.).
Flag Com.	Charles F. Smith (act.).
Temp. Eng.	Joseph H. Vinn (act.).

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Assistant Salvage Officers.

<i>Lieut.-Com. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> }	<i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> }
<i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> }	<i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> }
<i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> }	<i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> }
<i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> }	<i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> } <i>Lieut. R.N.V.R.</i> }

Superintendents of Contract-built Ships—

<i>Captain Cyril H. Fox, O.B.</i>	<i>For Contract Work (not including Destroyers) on the Clyde—</i>
<i>Captain William F. Slayter</i>	<i>Address—Broomhall Broomhill Drive, Parkle, Glasgow</i>
	<i>For Contract Work (not including Destroyers) on the Tyne, Thames, Mersey, at Birrow-in-Furness, and at Sunderland.</i>
	<i>Address—A, Osborne Villa, Osborne Avenue, Newcastle-on-Tyne.</i>

Captain Superintendent of Torpedo Boat Destroyers building by Contract—

Captain Frank E. Ruge, D.S.O. Address—27, Victoria Street, S.W.1.

DEPARTMENT OF THE DEPUTY CONTROLLER FOR DOCKYARDS AND SHIPBUILDING.

<i>Deputy Controller...Sir Thomas Hall, K.C.B.</i>	<i>Deputy Controller...Sir Thomas Hall, K.C.B.</i>
<i>Director of Dockyards and Repairs...Rear Admiral Laurence M. Power, O.B., M.V.O.</i>	<i>Deputy Director of Dockyards and Repairs...R. H. Dale, Esq., O.B.</i>
<i>Superintendent of Dockyard Branch—</i>	<i>Assistant Director of Dockyards and Repairs—</i>
<i>1. J. Wohl, Esq., O.B.</i>	<i>Eng. Captain Robert B. Dixon, O.B., M.N.</i>
<i>Electrical Engineering Assistant...W. McColland, Esq., O.B., M.I.E.E.</i>	<i>Secretary to D.O.D.S. P. C. Runtly, Esq.</i>
<i>Manager, Construction Department—</i>	<i>For Special Service—</i>
<i>P. B. Gills, Esq., (temp.). (For special service)</i>	<i>Eng. Rear-Admiral Charles Budd.</i>
<i>Chief Constructors—</i>	<i>Eng. Capt. Alfred M. Tompkins (ret.), R.N.</i>
<i>(1. M. Apsey, Esq., (temp.).</i>	<i>Eng. Capt. C. W. Murray (ret.), R.N.</i>
<i>(1. H. Crawford, Esq., (act.) (temp.).</i>	<i>Eng. Capt. Arthur S. Clegg, R.N.</i>
<i>Commander W. T. Davis, R.N.V.R. (act.) (temp.).</i>	<i>Engineer Assistants—</i>
<i>(1. G. Hall, Esq., (act.) (temp.).</i>	<i>Eng. Commander Samuel P. Ferguson.</i>
<i>Constructors—</i>	<i>Eng. Commander James G. Budge.</i>
<i>(1. J. H. Hall, Esq., M.N. (act.).</i>	<i>T. B. Wray, Esq., O.B. (sent from Haulbowline Dockyard.)</i>
<i>(1. P. Ludford, Esq., (act.).</i>	<i>B. R. Langlands, Esq.</i>
<i>J. McQueen, Esq., (act.).</i>	
<i>H. H. Wool, Esq., (act.).</i>	

Examiners of Dockyard Works—

W. H. C. Connors (act.), T. H. Hartley, M. A. Jacey, J. D. Hibby (act.), J. Miller, W. L. Cohen, P. Sanders, O. Bonward (act.), P. J. Fletcher (act.), J. A. Funn, M.N. (act.), W. J. Lewis (act.), J. H. Martin (act.), and G. Moody (act.), Esqs.

For Special Service.

Chief Administrative Officer...Major A. M. Wilson, R.M.L.I.

Medical Engineers Higher Grade...T. Edon (temp.), and J. B. Heddon, M.N., A.M.I.E.E. (act.), Esqs.
Electrical Engineers...E. L. Irwin, M.N. (act.), and A. B. Franklin (act.), Esqs.
First Assistant Electrical Engineers...H. V. Blake (act.), G. R. Irvine (act.), J. B. Irvine (act.), J. Murey (act.), and A. H. Williams (act.), Esqs.
Chief Assistant...G. C. Stainbury, Esq., (act.).
Senior Visiting Inspector of Timber...W. H. Homer, Esq.
Visiting Inspector of Timber...Alfred Maurer, Esq.
4 Dockyard Clerks (First Grade), 6 Dockyard Clerks (Second Grade), 1 Senior Draftsman, 1 First Class Draftsman, 11 Second Class Draftsman, 17 Clerks and Clerks (Third Class), 2 Illid Writers, 11 Temporary Clerks, 27 Female Clerks, 3 Female Time-keepers, and 10 Boys.

WARSHIP PRODUCTION SECTION.

LONDON STAFF.

Director of Warship Production...W. J. Henry, Esq., O.B.
Deputy Director of Warship Production...Engineer Rear-Admiral J. G. Liversidge, R.N. (ret.).
Assistant Director of Warship Production...Eng. Captain P. D. Marriott, R.N., M. A. J. Pearce, Esq., O.B.
Superintendent of Warship Production...W. H. Coxier, Esq.
Senior Engineer Assistant...Engineer Captain (ret.) Jasper W. A. Perrott.
Superintendent of Warship Electrical Works...J. McCaffery, Esq., O.B.

Appendix

- Chief Examiner and Secretary to Director of Warship Production*... R. J. Wilshk, Esq.
Constructors... A. Adams (act.), G. Mulkeley (act.), J. W. Dwyer (act.), J. G. Jonathan, M.B.E.,
 F. T. Moyer (act.), and E. P. Spammer (act.), Esqrs.
Engineer Assistants... Engineer Captain W. A. Wilson C.M.O. (act.), R.S., Engineer Commander William
 H. (Harko, D.S.O., R.N., Engineer Commandant F. A. Gordon, M.B.E., E. A. Andrieux, Esq., W. G.
 Matthews (temp.), Esq.
Electrical Engineers... A. J. Tynon (act.), A. J. Moore, A.M.I.E.E. (act.), Esqrs.
Assistant Constructors... D. E. J. O'Sullivan (2nd class), H. S. Pengelly (2nd class), V. G. Shephard (2nd class),
 J. W. Westlake (temp., act.), W. E. Saunders (temp., act.), W. J. Craig, M.B.E. (temp.), G. I.
 Harvey (temp.), W. J. Maier (temp.), R. Macmillan (temp.), and R. Whithing (temp.), Esqrs.
Financial Inspectors... R. C. Knight (temp.), W. J. Stallion (act.), Esqrs.
Engineer Inspectors (Temp)... R. N. Brown, G. Harlow, F. Penlon, L. H. Poyntz, W. Gullale, Esqrs.
 Lieut. H. W. Gill, R. Thund, G. Thobson, D. Hutchison, L. J. Nichol, Esqrs.
Inspecting Officer... W. G. Thomas (ret.), Esq.
First Assistant Electrical Engineers... C. E. Jowett (act.), C. H. Klyne (act.), E. F. Kili (act.),
 H. D. Thompson, Esqrs.
Examiners of Accounts... J. T. Hartwell, Esq. (act.), E. R. Rogers (temp.), C. Taylor (temp.), and
 W. E. Vanstone (act), Esqrs.
Assistant Examiners of Accounts... T. East (act.), J. Goulden (act.), W. Day (act.), W. J. Carr (act.),
 F. G. Gray (act.), H. Holba (act.), S. W. R. Puppel (act.), E. Wilson (act.), Esqrs.
 2 Dockyard Clerks (First Grade), 5 Dockyard Clerks (act.) (Second Grade), 8 Draughtsmen, 5 Dock-
 yard Clerks (act.) (Third Grade), 50 Temporary Clerks (female), and 26 Temporary Clerks (male).

OUTDOOR STAFF.

GLYD.

- Warship Production Superintendent*... S. E. Boyland, Esq. Address—105, West George Street, Glasgow.
Deputy Warship Production Superintendent... M. W. Searle, Esq.
Warship Production Inspectors... A. G. Beards, F. J. Berry, J. Bryant, W. E. Head, W. T. Hoskin,
 W. R. Hugman, R. G. McChiloch, Esqrs.
Warship Production Inspectors (Engineers)... J. Appleby, W. Bugge, D. McMillan, M. Munro, Esqrs.
Warship Production Inspectors (Electrical)... F. W. Robson and H. J. Stephens, Esqrs.

TYNE.

- Warship Production Superintendent*... Address—"Millburn House," Newcastle-on-Tyne.
Deputy Warship Production Superintendent... J. Inner, Esq.
Warship Production Inspectors... E. J. F. Lenthurchy, J. J. N. Bates, A. S. Blatchford, A. E. Moore,
 J. W. Turner, J. Sampson, Esqrs.
Warship Production Inspectors (Engineers)... U. Cowe, J. Findlay, T. McBride, C. Stuart, Esqrs.
Warship Production Inspectors (Electrical)... E. B. Moavens and B. Smith, Esqrs.

MERRY.

- Warship Production Superintendent*... T. D. Stansfield, M.B.E., Esq. Address—233, Royal Liver Buildings,
 Liverpool.
Deputy Warship Production Superintendent... P. Wright, Esq.
Warship Production Inspectors... W. J. Bunday, B. A. Gawden, H. W. M. Harrison, T. M. Taylor, Esqrs.
Warship Production Inspectors (Engineers)... E. Gould, J. Howells, O. Verity, Esqrs.
Warship Production Inspectors (Electrical)... F. H. Ager and A. M. Fenner, Esqrs.
Warship Production Inspector (Engineers)... F. McFarlane, Esq.

LONDON AND SOUTHERN DISTRICT.

Warship Production Superintendent... J. R. Linning, Esq.

MANCHESTER, Salford, and LEEDS DISTRICT.

Engineer Inspector... S. H. Warren, Esq.

BIRMINGHAM, COVENTRY, and LIVERPOOL DISTRICT.

Engineer Inspector... H. H. Peters, Esq.

3 Dockyard Clerks (Second Grade), 9 Dockyard Clerks (Third Grade), and 20 Temporary Clerks.

DIRECTORATE OF AUXILIARY VESSELS.

- Director of Auxiliary Vessels*... A. W. Sampson, Esq.
Assistant Directors of Auxiliary Vessels... Commander J. Bloomfield, O.B.E., R.N.V.R.
 R. M. Mills, Esq.
Deputy Assistant Directors of Auxiliary Vessels... Major T. B. Oull, M.B.E.
 C. Scott, Esq.
 Capt. W. E. Turner, M.B.
Administrative Officer... H. W. Butler, Esq.

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Technical Assistants.

Lieut. J. L. Ashworth.
C. C. Alward.
C. N. Ash.
W. H. Bouoy.
D. F. Black.
H. G. Bone.
Major C. C. Bond, R.N.
Captain B. A. Bockle, R.N.
R. Carr.
R. Chalmers.
2nd Lieut. J. P. Duguid, R.N.
Major D. Dawson, R.N.
J. Dunsmuir.
J. V. Fuller.
W. Galbraith.
Lieut. W. (Rimmell).
Captain J. G. Harrison, R.N.
J. G. Hart.
H. B. Hodgo.
Lieut. B. Q. Ikin, R.N.

A. Kyte.
M. H. McEwan.
Lieut. J. M. MacGheist.
J. Miller.
T. R. Morrison.
J. Munro.
Lieut. P. J. S. Munro, R.N.
Eng. Lieut.-Comm. P. Lusk, R.N.
Lieut. E. Puddy, R.N.
Eng.-Lieut. J. Sampson, R.N.
H. Sheppard.
Lieut. R. A. Shott, R.N.
Eng. Sub-Lieut. C. W. L. Slater, R.N.R.
Lieut. J. W. Smith, R.N.
Captain D. Strang, R.N.
Lieut. E. A. How, R.N.
Lieut. S. Townshend, R.N.
H. Watson.
S. R. Wells.

DEPARTMENT OF THE DEPUTY CONTROLLER FOR ARMAMENT PRODUCTION.

Deputy Controller...*Sir* Vincent L. Raven, K.C.B.E.
Secretary...*W.* H. Pettifor, Esq., O.B.E.
Naval Assistant...*Eng. Com.* Arthur E. Lester, D.S.O., R.N.
Chief Assistant to D.C.A.P....*Errol* Nash, Esq.
Technical Assistant...*H.* T. Hoar, Esq. *Administrative Staff Officer*...*Major* S. Robinson.
Chief Draughtsman...*C.* Walr, Esq.
Director of Production, Guns, Mountings and Sights...*J.* I. G. Loverson, Esq.
Deputy Director of Production, Guns, Mountings and Sights...*H.* S. Russell, Esq.
Assistant Directors of Production, Guns, Mountings and Sights...*R.* T. Glascombe, Esq., and
Major D. Kirko Smith, D.S.O.
Deputy Assistant Director of Production, Guns, Mountings and Sights...*C.* J. B. Orton, Esq.
Technical Assistants—Guns, &c., Division...*J.* Conlon, *H.* T. Dobbs, *W.* Methven (act.),
F. R. Roberts, Esqrs., and *Lieut.* R. H. B. M. P. de Lisle, R.N.
Director of Production—Torpedoes and Mines...*A.* H. Hall, Esq., O.B.E.
Deputy Director of Production—Torpedoes and Mines...*Commr.* Carlton C. Sherman, O.B.E., R.N. (act.) (rel.).
Assistant Director of Production—Torpedoes and Mines...*H.* A. D. Asland, Esq.
Technical Assistants—Mine Division...*W.* A. Harris, *A.* J. Jack, *L.* King, *C.* S. Leithard, *N.* M. Noble,
 and *J.* S. McLaren, Esqrs.
Assistant Director of Production—Mines—Group Section...*Lieut.* R.N.Y.R. Leslie G. Shadbolt.
Technical Assistants—Mines—Group Sections...*W.* L. O. Evans, *G.* V. Fowler, *T.* V. Goodman,
E. V. Housley, *H.* H. Hobb, *G.* W. Kettlewell, *W.* J. Scott, *W.* G. Smith, and *J.* Torrie, Esqrs.
Paravane Section...*Lieut.-Commr.* *W.* H. McConnell, O.B.E., R.N.V.R.
Minesweeping Section...*A.* H. Norrish, Esq.
Director of Production—Ammunition...*G.* L. Woodward, Esq., C.B.E.
Deputy Director of Production—Ammunition...*Lieut.-Comm.* *H.* S. H. Ellis, R.N. (rel.).
Assistant Directors of Production—Ammunition...*F.* S. MacNelly and *A.* H. Romann, Esqrs.
Deputy Assistant Directors of Production—Ammunition...*W.* F. Jenson and *W.* A. Reero, Esqrs.
Technical Assistants—Ammunition Division...*Lieut.* *C.* J. Barton, R.N.A., *E.* B. Denleigh, *E.* Knight,
H. Maddock, and *H.* M. Rao, Esqrs., and *Mrs.* Wylt Hayward.

AIRSHIP PRODUCTION.

Director of Production...*H.* C. Given, Esq.
Deputy Director...*Captain* *J.* Malcolm Fraser (act.), R.N.V.R.
Head of Supply Section...*H.* O. Bosman, Esq.
Administrative Staff Officer...*Lieut. (Temp. Capt.)* *Frank* Edwards, R.A.F.
Airship Engine Design...*Eng. Commr.* *Leslie* Robins, R.N.
Eng. Lieut.-Comm. *Frederick* R. G. Turner, R.N.
Captain *Rey* C. Parry, D.S.O., R.A.F.
Captain *Alexander* Mob. Steele, R.A.F.
Technical Assistant...*F.* Warren, Esq.
Armament...*Lieut. (Temp. Capt.)* *H.* S. Pearson, R.A.F.
Electric and W/T Section...*Capt. (Temp. Major)* *Arthur* Price-Heed, R.A.F.
Captain *Arthur* J. Osborne, R.A.F.
Captain *G.* C. Batt, R.A.F.
Lieut. (Temp. Capt.) *William* B. Garrett, R.A.F.

- Central Hydrogen Section...* Major (Temp. Lt.-Col.) Sidney R. Lawcock, R.A.F.
 Major George M. T. Ross, R.A.F.
 Captain Charles A. Shuter, R.A.F.
 Captain Alfred H. White, R.A.F.
 Captain Cecil Lightfoot, R.A.F.
 Captain Lazarus S. M. Pyke, R.A.F.
 Captain Arthur F. H. Smallpiece, R.A.F.
 Captain John B. Butler, R.A.F.
 Captain Reginald E. Offenshaw, R.A.F.
 Lieut. Charles G. A. P. Stry, R.A.F.
 Lieut. Stanley P. Elliott, R.A.F.
 Lieut. Alfred C. Tapster, R.A.F.
 Lieut. Bernard L. C. Davis, R.A.F.
 Lieut. Harold Stoney, R.A.F.
 2nd Lieut. Andrew G. Allan, R.A.F.
- Technical Assistant (Laboratory)...* A. R. Griggs, Esq.
Assistant Design Constructor... C. I. R. Campbell, Esq.
Assistant Constructors... A. P. Cole, Esq.
 H. May, Esq.
 F. Sutcliffe, Esq.
- Progress and Inspection...* T. Turtou Jones, Esq.
Technical Assistants... Major Albert V. Thompson, R.A.F.
 Captain (Temp. Major) Harry Welch, R.A.F.
 Captain Edwin H. Haworth, R.A.F.
 Captain John D. Greenwood, R.A.F.
 Lieut. David Greenwood, R.A.F.
 2nd Lieut. Donald Y. Mattinson, R.A.F.
 F. Adamson and C. F. Smith, Esqs.
- Works...* Lieut. (Temp. Capt.) John W. V. Paul, R.A.F.
 Captain Percival M. Davson, R.A.F.
 Walter Sarel, Esq.
- Costs...* A. B. Wingfield and S. P. Higgins, Esqrs.
Overseers... Eng. Commr. Bertram Harvey, R.N.
- Assistant Constructors...* H. B. W. Evans, Esq.
 J. L. Bartlett, Esq.
 S. Payne, Esq.
- District Progress Engineers D.C.A.P. Dept...* Eng. Capt. W. H. Adams, R.N., London; Eng. Capt. W. J. Black, R.N., Harrow-on-the-Ussell; Eng. Capt. E. Collingwood, R.N., Newcastle-on-Tyne; W. Clemence, Esq., Nottingham; N. Clough, Esq., Manchester; W. S. Edwards, Esq., Birmingham; and J. H. Hollis, Esq., Glasgow.

FINANCE DIVISION.

- Assistant Accountant General...* A. Cunningham, Esq. (act.).
Superintending Clerk... A. H. M. Fox, Esq. (act.).
- Deputy Accounts Officers in charge of Branches...* H. B. Bain, Esq. (act.), C. H. Court, Esq. (act.), W. J. Houn, Esq. (act.), B. G. Peirce, Esq., M.D. (act.).
- Deputy Accounts Officers...* A. J. Cunn, Esq. (act.) (lent from National Insurance Audit Department), H. E. Denny, Esq. (act.) (lent from Inland Revenue), L. H. Gibson, Esq., A.M.A.A. (act.) (lent from National Insurance Audit Department), W. J. B. Greenland, Esq. (act.), F. R. Johnson, Esq. (act.) (lent from Inland Revenue).
- Assistant Accounts Officers...* G. J. Dear, Esq., S. T. Pepler, Esq. (act.), H. F. Skinner, Esq. (act.), E. Underwood, Esq. (act.), E. H. Westlake, Esq.
- Assistant Expense Accounts Officer...* E. Hall, Esq. (lent by Inspector of Dockyard Expense Accounts).
- Assistant Auditors (lent from National Insurance Audit Department)...* A. E. Codd, Esq., H. Foulds, Esq., E. G. Kouch, Esq.
- 1 Supervising Assistant Clerk, 1 Assistant Clerk, 1 Mixed Accountant Clerk, 14 Temporary Clerical Assistants, 6 Temporary Assistant Accountants, 80 Temporary Men Clerks, 2 Higher Grade Women Clerks, 80 Temporary Women Clerks and Typists, and 18 Improvers and Boy Clerks.
- Paymaster, Controller's Department...* Paym. Commr. Henry Horniman, R.N.

COSTINGS INVESTIGATION DIVISION.

- Adviser upon Costs of Production* } A. F. Whinney, Esq., F.C.A. (act.).
Assistant Accountant General }
Deputy... F. W. Payworth, Esq., A.S.A.A. (Acting Superintending Clerk).
Assistant... H. F. Palmer, Esq., M.B.D., A.C.A.
- Heads of Branches...* G. D. Britten, Esq., A.C.A.
 W. Ellis Hill, Esq., A.C.A.
 W. L. Karamell, Esq., A.S.A.A. (Acting Deputy Accounts Officer, lent from National Insurance Audit Dept.).
 F. N. Kidson, Esq., F.C.A.
 C. H. Oldfield, Esq., A.C.A.
 Martin Price, Esq., F.C.A.

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